IRIS ENVIRONMENTAL

Via Email and US Mail

March 11, 2013

John R. Moody
Project Manager
United States Environmental Protection Agency Region IX
75 Hawthorne Street
San Francisco, California 94105

Re: Soil Gas Health Risk Evaluation
Romic Environmental Technologies
Gila River Indian Community, Arizona

Dear Mr. Moody:

On behalf of Romic Environmental Technologies Corp. (Romic), Iris Environmental is transmitting a human health risk evaluation of the rebound soil gas data collected at the Romic Environmental Technologies facility at the Gila River Indian Community. The attached soil gas human health risk evaluation was conducted in accordance with the amended Romic RFI Work Plan and with our October 8, 2012 letter regarding Vapor Intrusion Modeling Input Parameters. The results of this evaluation indicate that concentrations of volatile chemicals measured in site soil gas in June 2011 are unlikely to result in significant adverse health impacts to future site users.

Concentrations of volatile organic compounds in site soil gas were measured in June 2011 at the seven shallow screened soil vapor extraction (SVE) wells, 16 months after the SVE system was shut down. Potential health impacts to hypothetical future site users (commercial/industrial workers) are quantified for two transport and exposure pathways: 1) inhalation of volatile chemicals which migrate upwards from soil gas to the indoor air space of an overlying building (vapor intrusion pathway); and 2) inhalation of volatile chemicals which migrate upwards from soil gas to outdoor air where there is no overlying building present.

The process for quantifying potential vapor intrusion health impacts associated with the soil gas data may be summarized as follows. Please refer to the attached technical report for details.

- Risk-based screening levels of volatile chemicals in indoor are developed in accordance with USEPA inhalation risk assessment methodology and assumptions. For each of the volatile chemicals detected in site soil gas, a cancer-based indoor air screening level and a chronic noncancer-based indoor air screening level are developed. Cancer- and noncancer-based screening levels are based on a target cancer risk of one in a million (1×10^{-6}) and a target chronic noncancer hazard quotient of unity (1.0), respectively, under a commercial/industrial land use scenario.

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- The transport of volatile chemicals from soil gas to the indoor air of a future commercial/industrial building is modeled using the USEPA-recommended Johnson and Ettinger advanced model for soil gas. The Johnson and Ettinger model is used to develop an attenuation factor for each volatile chemical detected in site soil gas. By definition, the attenuation factor is the ratio of the chemical concentration in indoor air (resulting from vapor intrusion transport) to the chemical concentration in soil gas beneath the building.
- For each volatile chemical detected in site soil gas, the cancer- and noncancer-based indoor air screening levels are combined with the attenuation factor to develop cancer- and noncancer-based soil gas screening levels. These cancer- and noncancer-based soil gas screening levels represent, by definition, the chemical concentrations in soil gas that would produce (through vapor intrusion) the target cancer risk of 1×10^{-6} and target noncancer hazard quotient of 1.0, respectively.
- The risk-based soil gas screening levels are applied to the site soil gas data to quantify the vapor intrusion cancer risk and noncancer hazard quotient associated with each individual soil gas sampling result. Chemical-specific risks and hazards are summed across all volatile chemicals detected in each soil gas sample, to quantify the cumulative (multi-chemical) vapor intrusion cancer risk and noncancer hazard index associated with each individual soil gas sample.

An analogous process to that summarized above is followed to evaluate potential health impacts associated with transport of volatile chemicals to *outdoor* air. An Iris Environmental-modified version of the Johnson and Ettinger model is used to develop a soil gas-to-outdoor air transfer factor (analogous to the vapor intrusion attenuation factor) for each volatile chemical. The cancer- and noncancer-based indoor air screening levels are combined with the transfer factor to develop cancer- and noncancer-based soil gas-to-outdoor air screening levels for each chemical. These screening levels are then used to quantify the cumulative (multi-chemical) outdoor air cancer risk and noncancer hazard index associated with each individual soil gas sample.

Estimated cumulative cancer risks and noncancer hazard indices are summarized in the table below.

	Indoor Air Pathway (Vapor Intrusion)				Outdoor Air Pathway			
	Default Evaluation		Site-specific Eval.		Default Evaluation		Site-specific Eval.	
Soil Gas Sample	Risk	Hazard	Risk	Hazard	Risk	Hazard	Risk	Hazard
VSP-061611-SVE-1	7.0E-07	5.0E-02	1.1E-07	7.7E-03	1.2E-08	8.5E-04	1.2E-09	8.6E-05
VSP-061611-SVE-2S	4.4E-07	1.9E-02	6.8E-08	3.0E-03	7.4E-09	3.3E-04	7.5E-10	3.3E-05
VSP-061611-SVE-3S	4.4E-07	3.1E-02	6.7E-08	4.8E-03	7.3E-09	5.3E-04	7.4E-10	5.4E-05
VSP-061611-SVE-4S	2.8E-07	7.1E-03	4.2E-08	1.1E-03	4.6E-09	1.2E-04	4.7E-10	1.2E-05
VSP-061611-SVE-5S	3.4E-07	1.0E-02	5.2E-08	1.5E-03	5.7E-09	1.7E-04	5.8E-10	1.7E-05
VSP-061611-SVE-6S	9.0E-08	3.3E-03	1.4E-08	5.1E-04	1.5E-09	5.7E-05	1.5E-10	5.7E-06
VSP-061611-SVE-7S	2.4E-07	9.1E-03	3.7E-08	1.4E-03	4.0E-09	1.5E-04	4.1E-10	1.6E-05
VSP-061611-SVE-7S-DUP	2.4E-07	8.5E-03	3.5E-08	1.3E-03	3.9E-09	1.4E-04	3.9E-10	1.5E-05

Estimated cumulative (multi-chemical) cancer risks and noncancer hazard indices are compared to thresholds of 1×10^{-6} (one in a million) 1.0, respectively. The USEPA and other regulatory agencies typically consider an excess (*i.e.*, above background) cancer risk level of 1×10^{-6} or less to be negligible. By definition, an excess noncancer hazard index of 1.0 or less indicates that the exposure is unlikely to result in adverse noncancer health effects.

In summary, estimated cumulative (multi-chemical) vapor intrusion and outdoor air cancer risks and noncancer hazards are below these thresholds of concern for all soil gas samples. These results indicate that the concentrations of volatile chemicals measured in site soil gas in June 2011 are unlikely to result in significant adverse health impacts to future site users.

Please don't hesitate to call us at (510) 834-4747 x21 or calger@irisenv.com if you have any questions regarding this soil gas health risk evaluation.

Sincerely,

IRIS ENVIRONMENTAL

Christopher S. Alger, P.G.
Principal Engineering Geologist

Gregory S. Noblet, P.E.
Senior Manager

Attachments: Soil Gas Health Risk Evaluation

cc: Wayne Kiso, Clarus Management Solutions
Thomas Suriano, Clear Creek Associates

SOIL GAS HEALTH RISK EVALUATION

Former Romic Environmental Technologies Facility

6760 West Allison Road

Gila River Indian Community, Chandler, Arizona

March 11, 2013

Prepared for:

Romic Environmental Technologies Corporation

Prepared by:

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Oakland, California 94612

Project No. 07-555B

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Appendices

1.0 INTRODUCTION

This report documents the methodology and results of a human health risk evaluation of soil gas data collected at the former Romic Environmental Technologies facility in the Gila River Indian Community in Arizona. The post-rebound soil gas data evaluated here were collected in June 2011 through the soil vapor extraction (SVE) system wells that previously operated at the site. Two potential transport and exposure pathways are considered in this evaluation: transport of volatile chemicals from soil gas to the indoor air space of a hypothetical future overlying building (*i.e.*, vapor intrusion); and 2) transport of volatile chemicals from soil gas to outdoor air. The potential inhalation cancer risk and noncancer hazard to hypothetical future site occupants (commercial/industrial workers) are quantified for both pathways: indoor air and outdoor air. Methodologies and assumptions of the transport and inhalation risk evaluations are consistent with United States Environmental Protection Agency (USEPA) and California Environmental Protection Agency (Cal/EPA) guidance.

2.0 TRANSPORT TO INDOOR AIR (VAPOR INTRUSION)

2.1 Overview

The potential health impacts associated with vapor intrusion of volatile compounds from soil gas into the indoor air space of future onsite buildings are evaluated by the following processes:

- Risk-based screening levels of volatile chemicals in indoor air are developed in accordance with USEPA and Cal/EPA inhalation risk assessment methodology and assumptions. For each of the 14 volatile chemicals detected in site soil gas (*i.e.*, for each chemical of potential concern [COPC]), a cancer-based indoor air screening level and a chronic noncancer-based indoor air screening level are developed. Cancer- and noncancer-based screening levels are based on a target cancer risk of one in a million (1×10^{-6}) and a target chronic noncancer hazard quotient of unity (1.0), respectively, under a commercial/industrial land use scenario.
- The transport of volatile chemicals from soil gas to the indoor air of a future commercial/industrial building is modeled using the USEPA-recommended Johnson and Ettinger advanced model for soil gas (SG-ADV Version 3.1) (Johnson and Ettinger, 1991; USEPA, 2004), as modified by Iris Environmental to allow the input of multiple chemicals at one time. The Johnson and Ettinger model is used to develop an attenuation factor for each volatile chemical detected in site soil gas. By definition, the attenuation factor is the ratio of the chemical concentration in indoor air (resulting from vapor intrusion transport) to the chemical concentration in soil gas beneath the building.
- For each volatile chemical detected in site soil gas, the cancer- and noncancer-based indoor air screening levels are combined with the attenuation factor to develop cancer- and noncancer-based soil gas screening levels. These cancer- and noncancer-based soil gas screening levels represent, by definition, the chemical concentrations in soil

gas that would produce (through vapor intrusion) the target cancer risk of 1×10^{-6} and target noncancer hazard quotient of 1.0, respectively.

- The risk-based soil gas screening levels are applied to the site soil gas data to quantify the vapor intrusion cancer risk and noncancer hazard quotient associated with each individual soil gas sampling result. Chemical-specific risks and hazards are summed across all volatile chemicals detected in each soil gas sample, to quantify the cumulative (multi-chemical) vapor intrusion cancer risk and noncancer hazard index associated with each individual soil gas sample.

This vapor intrusion evaluation of the site soil gas data is documented in greater detail below.

2.2 Indoor Air Risk-based Screening Levels

Risk-based screening levels of volatile chemicals in indoor air under commercial/industrial land use are developed here in accordance with standard USEPA inhalation risk assessment methodology and exposure assumptions (USEPA, 1989; 1991; 2009), and using current USEPA-published toxicity data (USEPA, 2012; 2013). Cancer- and noncancer-based screening levels are based on a target cancer risk of 1×10^{-6} and a target noncancer hazard quotient of 1.0, respectively. Commercial/industrial worker exposure assumptions and inhalation toxicity values are documented in Tables 1 and 2, respectively. The calculated cancer- and noncancer-based indoor air screening levels are presented in Table 3.

2.3 Attenuation Factors

The transport of volatile chemicals from soil gas to indoor air is modeled using the USEPA-recommended Johnson and Ettinger advanced model for soil gas (SG-ADV Version 3.1) (Johnson and Ettinger, 1991; USEPA, 2004), as modified by Iris Environmental to allow the input of multiple chemicals at one time. Two sets of attenuation factors are developed here: 1) default attenuation factors based on conservative default soil properties; and 2) site-specific attenuation factors based on site-specific soil properties. Model input data are documented in Tables 4 through 6, and are discussed below. Model calculations and results (attenuation factors) are presented in Tables 7 and 8.

2.3.1 Source Characterization

Each volatile COPC is assumed to be present in soil gas at a unit concentration of 1 $\mu g/m^3$. For developing default and site-specific attenuation factors, soil gas impacts are assumed to be present at depths of 49 centimeters and 304 centimeters below ground surface, respectively, as explained below (see Section 2.3.2). Physicochemical properties of COPCs are obtained from the USEPA version of the Johnson and Ettinger model (USEPA, 2004). Physicochemical properties are documented in Table 6.

2.3.2 Lithology and Soil Properties

For developing default attenuation factors, soil properties and other model inputs are set to conservative default values used by the Cal/EPA Office of Environmental Health Hazard

Assessment (OEHHA) in calculating California Human Health Screening Levels (CHHSLs) for shallow soil gas under future commercial/industrial buildings (Cal/EPA, 2005). Under this default scenario, soil gas impacts are assumed present at a depth of 49 centimeters (1.6 feet) below grade, beneath a 30-cm thick layer of engineered fill, 10-centimeter thick layer of sand, and 9-centimeter thick building slab.

For developing site-specific attenuation factors, the depth to soil gas contamination is assumed to be 304 centimeters (10.0 feet), consistent with the depth to the top of the soil vapor extraction (SVE) system well screens. The site lithology between the ground surface and 10 feet bgs is modeled as a single layer of fill material with site-specific soil properties determined from the geotechnical analyses of soil samples GTB-01 @ 5.5-6 feet and 16.0-16.5 feet. Site-specific soil properties are summarized in Table 4. The geotechnical laboratory report is included in Appendix A.

Lithology- and soil-related input values are summarized in Table 5.

2.3.3 Building Properties

Both the default and site-specific attenuation factors developed here are based on the same conservative default assumptions used by OEHHA in development of soil gas CHHSLs for future commercial/industrial buildings (Cal/EPA, 2005; 2010). Building-related input values are summarized in Table 5.

2.3.4 Modeling Results

The output parameter of the Johnson and Ettinger model is the attenuation factor. By definition, the attenuation factor is the ratio of the chemical concentration in indoor air (resulting from vapor intrusion transport) to the chemical concentration in soil gas beneath the building. Attenuation factors for the 14 volatile chemicals detected in site soil gas are calculated in Table 7 (default evaluation) and Table 8 (site-specific evaluation).

2.4 Soil Gas Risk-based Screening Levels

The cancer- and noncancer-based indoor air risk-based screening levels represent, by definition, the volatile chemical concentrations in indoor air that would produce the target cancer risk of 1×10^{-6} and target noncancer hazard quotient of 1.0, respectively. Each attenuation factor is, by definition, the ratio of the chemical concentration in indoor air (resulting from vapor intrusion transport) to the chemical concentration in soil gas beneath the building. Therefore, for each volatile COPC, cancer- and noncancer-based soil gas screening levels are calculated by multiplying the cancer- and noncancer-based indoor air screening levels by the attenuation factor. These resulting cancer- and noncancer-based soil gas risk-based screening levels represent, by definition, the chemical concentrations in soil gas that would produce (through vapor intrusion) the target cancer risk of 1×10^{-6} and target noncancer hazard quotient of 1.0, respectively. Default and site-specific soil gas risk-based screening levels are presented in Tables 9 and 10, respectively.

2.5 Cumulative Vapor Intrusion Risk and Hazard

By definition, each cancer- or noncancer-based soil gas screening level represents the concentration of the associated volatile chemical in soil gas that would produce (through vapor intrusion) the target cancer risk of 1×10^{-6} or target noncancer hazard quotient of 1.0. Thus, the cancer risk and noncancer associated with a measured concentration of a volatile chemcial in soil gas are calculated by taking the ratios of the measured concentration in soil gas to the cancer- and noncancer-based screening levels, and multiplying these ratios by the target risk level of 1×10^{-6} and target noncancer hazard quotient of 1.0. The calculation of risk and hazard is documented in Table 11 (default evaluation) and Table 12 (site-specific evaluation) for the site soil gas samples.

As a matter of policy, USEPA (1989) considers the potential cancer risks from exposure to multiple carcinogens to be additive, regardless of the carcinogens' mechanisms of toxicity or sites (organs of the body) of action. Therefore, the chemical-specific cancer risks are summed across all detected carcinogenic chemicals to produce an estimate of the cumulative (multi-chemical) vapor intrusion cancer risk associated with each soil gas sample. The chemical-specific noncancer hazard quotients are also summed across all detected chemicals to produce an estimate of the cumulative (multi-chemical) inhalation hazard index associated with each soil gas sample. The summation of hazard quotients across chemicals, independent of the target organ(s) affected by each chemical, is conservative, as chemicals that impact different target organs (e.g., liver, kidney) are not truly additive in their potential to cause the adverse impact. Cumulative vapor intrusion cancer risks and noncancer hazard indices are shown at the bottom of Table 11 (default evaluation) and Table 12 (site-specific evaluation), and are summarized in Table 13.

These estimated vapor intrusion risk and hazards are discussed below in Section 4.0.

3.0 TRANSPORT TO OUTDOOR AIR

3.1 Overview

The potential health impacts associated with transport of volatile compounds from soil gas to *outdoor* air are evaluated by a nearly identical process to that described above in Section 2.0. The only difference from the preceding vapor intrusion evaluation is that the soil gas-to-*indoor* air attenuation factor is replaced here by a soil gas-to-*outdoor* air "transfer factor". It is noted that, given the same site soil gas impacts, transport to outdoor air is much less significant than transport to indoor air (vapor intrusion), because volatile chemicals emitted to outdoor air are dispersed into a relatively large volume of air whereas volatile chemicals emitted to indoor air accumulate within a relatively small building volume.

3.2 Outdoor Air Risk-based Screening Levels

Risk-based screening levels of volatile chemicals in outdoor air are the same as those for indoor air, which are described above in Section 2.2 and presented in Table 3.

3.3 Transfer Factors

The transport of volatile chemicals from soil gas to outdoor air is modeled using a modified version of the USEPA-recommended Johnson and Ettinger advanced model for soil gas. This modified "outdoor air model" makes use of the same physicochemical property data (see Table 6) and the same lithology and soil property data (see Tables 4 and 5) as the standard Johnson and Ettinger model, to simulative the diffusive transport of volatile chemicals upwards through the subsurface. Two modifications are made to the standard Johnson and Ettinger model in order to simulate transport to outdoor rather than indoor air.

- In the standard Johnson and Ettinger model, the effective diffusivity coefficient and the Fickian diffusive flux are based on vertical transport from the depth of impact to the bottom of the building slab, which is assumed to be 9 centimeters below grade. In the outdoor air model, the effective diffusivity coefficient and the Fickian diffusive flux are based on vertical transport from the depth of impact to the ground surface. In other words, the diffusion path length is slightly greater in the outdoor air model.
- In the standard Johnson and Ettinger model, volatile chemicals that have reached the bottom of the building slab by Fickian diffusion are then transported into the overlying building by advection (*i.e.*, by bulk air flow through cracks in the building slab), to an extent determined by the bulk air flow rate into the building, building volume, and building air exchange (ventilation) rate. In the outdoor air model, volatile chemicals are emitted into outdoor air at the rate given by the Fickian diffusive flux, and are then dispersed into a volume of outdoor air as described by the USEPA-recommended "Q over C" dispersion factor. This dispersion calculation is described further below.

As noted above, the diffusive flux of each volatile chemical from the ground surface into outdoor air is estimated using the Johnson and Ettinger model, modified to account for the slightly greater transport distance. Given this estimated emissions flux, the soil gas-to-outdoor air transfer factor is calculated from the following (USEPA, 1996a; 1996b; 2000):

$$TF = \frac{F/C_{SG}}{[Q/C]_{vol}} \times 10^{+9}$$

where:

TF	=	soil gas-to-outdoor air transfer factor (μg/m^3 per μg/m^3);
F	=	diffusive flux (g/m^2/s) calculated by modified Johnson and Ettinger model;
C_{SG}	=	unit chemical concentration in soil gas (1 μg/m^3);
$[Q/C]_{vol}$	=	site-specific Q-over-C volatile dispersion factor (g/m^2/s per kg/m^3) calculated using USEPA methodology and data (see below); and
10^{+9}	=	unit conversion factor (μg/kg).

The dispersion of volatile chemicals into outdoor air is represented by the Q-over-C dispersion factor. A site-specific dispersion factor is developed here using the methodology and input data given in the USEPA Soil Screening Guidance (USEPA, 1996a; 1996b; 2000). The site-specific dispersion factor is calculated using climate-specific dispersion coefficients and a site-specific source/mixing area of 0.5 acres, which is the smallest and most conservative value that can be used with the Q-over-C methodology per the Soil Screening Guidance. The calculation of the site-specific Q-over-C dispersion factor is documented in Table 14.

Soil gas-to-outdoor air transfer factors for the 14 volatile chemicals detected in site soil gas are calculated in Table 15 (default evaluation) and Table 16 (site-specific evaluation).

3.4 Soil Gas-to-Outdoor Air Risk-based Screening Levels

The cancer- and noncancer-based outdoor air risk-based screening levels represent, by definition, the volatile chemical concentrations in outdoor air that would produce the target cancer risk of 1×10^{-6} and target noncancer hazard quotient of 1.0, respectively. Each transfer factor is, by definition, the ratio of the chemical concentration in outdoor air (resulting from vapor transport) to the chemical concentration in underlying soil gas. Therefore, for each volatile COPC, cancer- and noncancer-based soil gas-to-outdoor air screening levels are calculated by multiplying the cancer- and noncancer-based outdoor air screening levels by the transfer factor. These resulting cancer- and noncancer-based soil gas-to-outdoor air risk-based screening levels represent, by definition, the chemical concentrations in soil gas that would produce (through vapor transport to outdoor air) the target cancer risk of 1×10^{-6} and target noncancer hazard quotient of 1.0, respectively. Soil gas-to-outdoor air risk-based screening levels are presented in Tables 17 and 18, respectively.

3.5 Cumulative Outdoor Air Risk and Hazard

By definition, each cancer- or noncancer-based soil gas-to-outdoor air screening level represents the concentration of the associated volatile chemical in soil gas that would produce (through vapor transport to outdoor air) the target cancer risk of 1×10^{-6} or target noncancer hazard quotient of 1.0. Thus, the cancer risk and noncancer associated with a measured concentration of a volatile chemical in soil gas are calculated by taking the ratios of the measured concentration in soil gas to the cancer- and noncancer-based screening levels, and multiplying these ratios by the target risk level of 1×10^{-6} and target noncancer hazard quotient of 1.0. The calculation of outdoor air risk and hazard for the site soil gas samples is documented in Table 19 (default evaluation) and Table 20 (site-specific evaluation).

Analagous to the calculation of cumulative (multi-chemical) risk and hazard for the vapor intrusion pathway (see Section 2.5 above), the chemical-specific cancer risks are summed across all detected carcinogenic chemicals to produce an estimate of the cumulative (multi-chemical) vapor intrusion cancer risk associated with each soil gas sample. The chemical-specific noncancer hazard quotients are also summed across all detected chemicals to produce an estimate of the cumulative (multi-chemical) inhalation hazard index associated with each soil gas sample. Cumulative soil gas-to-outdoor air cancer risks and noncancer hazard indices are shown at the bottom of Table 19 (default evaluation) and Table 20 (site-specific evaluation), and are summarized in Table 21.

These estimated outdoor air risk and hazards are discussed below in Section 4.0.

4.0 SUMMARY AND CONCLUSIONS

For each of the eight site soil gas samples, the estimated cumulative (multi-chemical) cancer risks and noncancer hazard indices associated with transport of volatile chemicals from soil gas to indoor air (vapor intrusion) are summarized in Table 14, for both the default and site-specific transport evaluations. The greatest estimated risk and hazard are associated with soil gas sample VSP-061611-SVE-1. The cumulative (multi-chemical) vapor intrusion cancer risk and noncancer hazard index associated with this worst-case sample are 7.0×10^{-7} and 5.0×10^{-2}, respectively, under the default scenario. Cumulative risk and hazard for this sample (and all samples) are lower under the site-specific scenario than the default scenario; cumulative risk and hazard associated with the worst-case soil gas sample, under the site-specific evaluation, are 1.1×10^{-7} and 7.7×10^{-3}, respectively.

For each of the eight site soil gas samples, the estimated cumulative cancer risks and noncancer hazard indices associated with transport of volatile chemicals from soil gas to outdoor air are summarized in Table 21, for both the default and site-specific transport evaluations. The cumulative outdoor air cancer risk and noncancer hazard index associated with worst-case sample VSP-061611-SVE-1 are 1.2×10^{-8} and 8.5×10^{-4}, respectively, under the default scenario. Cumulative outdoor air risk and hazard associated with the worst-case soil gas sample, under the site-specific evaluation, are 1.2×10^{-9} and 8.6×10^{-5}, respectively.

The USEPA and other regulatory agencies typically consider an excess (*i.e.*, above background) cancer risk level of 1×10^{-6} or less to be negligible. By definition, an excess noncancer hazard index of 1.0 or less indicates that the exposure is unlikely to result in adverse noncancer health effects. Estimated cumulative (multi-chemical) vapor intrusion and outdoor air cancer risks and noncancer hazards are below these thresholds of concern for all soil gas samples, including under the conservative default modeling scenario. The worst-case result from this evaluation, the predicted vapor intrusion cancer risk of 7.0×10^{-7} associated with soil gas sample VSP-061611-SVE-1, is below the negligible risk level of 1×10^{-6}. In summary, the concentrations of volatile chemicals measured in site soil gas in June 2011 are unlikely to result in significant adverse health impacts to future site users.

5.0 REFERENCES

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Tables

Table 1. Exposure Assumptions – Commercial/Industrial Land Use

Parameter		Units	Value	Note
TRISK	Target risk	none	1.0E-06	–
THQ	Target hazard quotient	none	1.0	–
ET	Exposure time	hr/d	8	USEPA default (USEPA, 2009)
EF	Exposure frequency	d/yr	250	USEPA default (USEPA, 1991)
ED	Exposure duration	yr	25	USEPA default (USEPA, 1991)
ATca	Averaging time, cancer effects	d	25,550	USEPA default (USEPA, 1989)
ATnc	Averaging time, noncancer effects	d	9,125	USEPA default (USEPA, 1989)

Notes:

(1) Exposure assumptions are consistent with default USEPA assumptions for commercial/industrial land use (USEPA, 1989; 1991; 2009).

Table 2. Cancer and Noncancer Inhalation Toxicity Values

Chemical	Unit Risk Factor		Chronic Reference Concentration	
	Value (per μg/m^3)	Source	Value (μg/m^3)	Source
Acetone	nc		3.1E+04	RSLs-A
Butanone, 2-	nc		5.0E+03	IRIS
Chloroform	2.3E-05	IRIS	9.8E+01	RSLs-A
Dichloroethane, 1,1-	1.6E-06	RSLs-C	7.0E+02	RSLs-P (rtr)
Dichloroethane, 1,2-	2.6E-05	IRIS	7.0E+00	RSLs-P
Dichloroethene, 1,1-	nc		2.0E+02	IRIS
Dichloroethene, 1,2-, cis-	nc		7.0E+00	IRIS (rtr)
Methylene chloride	4.7E-07	IRIS	1.0E+03	RSLs-A
Tetrachloroethene	5.9E-06	RSLs-C	2.7E+02	RSLs-A
Trichloroethane, 1,1,1-	nc		5.0E+03	IRIS
Trichloroethane, 1,1,2-	1.6E-05	IRIS	2.0E-01	RSLs-X
Trichloroethene	4.8E-06	IRIS	2.0E+00	IRIS
Trichlorofluoromethane	nc		7.0E+02	RSLs-H
Trichlorotrifluoroethane, 1,1,2-, 1,2,2-	nc		3.0E+04	RSLs-H

Notes:

(1) The sources of inhalation toxicity values are:

IRIS – USEPA Integrated Risk Information System (IRIS) database (USEPA, 2012b);

RSLs – USEPA Regional Screening Levels (RSLs) table (USEPA, 2012a) where primary sources are: I – IRIS; P – PPRTV; A – ATSDR; C – Cal/EPA; X – PPRTV Appendix; and H – HEAST.

(2) "rtr" indicates route-to-route extrapolation – a published oral toxicity value is assumed to be applicable to the inhalation pathway. First, an inhalation reference dose (mg/kg/d) is assumed to be equal in value to the published oral reference dose (mg/kg/d). The inhalation reference dose (mg/kg/d) is then converted to an inhalation reference exposure level (μg/m^3) by assuming a receptor breathing rate of 20 m^3/d and body weight of 70 kg.

(3) "nc" indicates chemical is a noncarcinogen.

Table 3. Indoor Air Risk-based Screening Levels – Commercial/Industrial Land Use

	Cancer Effects							Noncancer Effects						
Chemical	Unit Risk Factor, URF (per µg/m³)	Exposure Time, ET (hr/d)	Exposure Frequency, EF (d/yr)	Exposure Duration, ED (yr)	Averaging Time, ATca (d)	Target Risk, TR	Risk-based Screening Level, IASLca (µg/m³)	Reference Concentration, RfC (µg/m³)	Exposure Time, ET (hr/d)	Exposure Frequency, EF (d/yr)	Exposure Duration, ED (yr)	Averaging Time, ATnc (d)	Target Hazard Quotient, THQ	Risk-based Screening Level, IASLnc (µg/m³)
Acetone	nc	8	250	25	25,550	1.E-06	nc	3.10E+04	8	250	25	9,125	1.E+00	1.4E+05
Butanone, 2-	nc	8	250	25	25,550	1.E-06	nc	5.00E+03	8	250	25	9,125	1.E+00	2.2E+04
Chloroform	2.30E-05	8	250	25	25,550	1.E-06	5.3E-01	9.80E+01	8	250	25	9,125	1.E+00	4.3E+02
Dichloroethane, 1,1-	1.60E-06	8	250	25	25,550	1.E-06	7.7E+00	7.00E+02	8	250	25	9,125	1.E+00	3.1E+03
Dichloroethane, 1,2-	2.60E-05	8	250	25	25,550	1.E-06	4.7E-01	7.00E+00	8	250	25	9,125	1.E+00	3.1E+01
Dichloroethene, 1,1-	nc	8	250	25	25,550	1.E-06	nc	2.00E+02	8	250	25	9,125	1.E+00	8.8E+02
Dichloroethene, 1,2-, cis-	nc	8	250	25	25,550	1.E-06	nc	7.00E+00	8	250	25	9,125	1.E+00	3.1E+01
Methylene chloride	4.70E-07	8	250	25	25,550	1.E-06	2.6E+01	1.00E+03	8	250	25	9,125	1.E+00	4.4E+03
Tetrachloroethene	5.90E-06	8	250	25	25,550	1.E-06	2.1E+00	2.70E+02	8	250	25	9,125	1.E+00	1.2E+03
Trichloroethane, 1,1,1-	nc	8	250	25	25,550	1.E-06	nc	5.00E+03	8	250	25	9,125	1.E+00	2.2E+04
Trichloroethane, 1,1,2-	1.60E-05	8	250	25	25,550	1.E-06	7.7E-01	2.00E-01	8	250	25	9,125	1.E+00	8.8E-01
Trichloroethene	4.80E-06	8	250	25	25,550	1.E-06	2.6E+00	2.00E+00	8	250	25	9,125	1.E+00	8.8E+00
Trichlorofluoromethane	nc	8	250	25	25,550	1.E-06	nc	7.00E+02	8	250	25	9,125	1.E+00	3.1E+03
Trichlorotrifluoroethane, 1,1,2-, 1,2,2	nc	8	250	25	25,550	1.E-06	nc	3.00E+04	8	250	25	9,125	1.E+00	1.3E+05

Notes:

(1) Indoor air screening levels are developed in accordance with USEPA methodology and assumptions for commercial/industrial land use (USEPA, 1989; 1991; 2009; 2012a; 2012b). Cancer- and noncancer-based concentrations are based on target risk of 1E-06 and target hazard quotient of 1.0, respectively.

Table 4. Site-specific Soil Properties

Sample ID	Sample Depth (ft)	Dry Bulk Density (g/cm^3)	Water Content (g/g)	Total Porosity (cm^3/cm^3)	Water Density (g/cm^3)	Water-filled Porosity (cm^3/cm^3)	Air-filled Porosity (cm^3/cm^3)
GTB-01@5.5-6.0	5.5-6.0	1.79	0.099	0.335	1.00	0.177	0.158
GTB-01@16.0-16.5	16.0-16.5	1.65	0.227	0.366	1.00	0.366	0.000

Notes:

(1) Dry bulk density, water content, and total porosity are from Speedie and Associates Laboratory Report No. 120880L/

(2) Water density is assumed.

(3) Water-filled porosity (θ_w) is calculated from:

$$\theta_w = \omega \times \frac{\rho_s}{\rho_w}$$

where ω is water content, ρ_s is dry bulk density, and ρ_w is water density. If this calculated value of water-filled porosity exceeds the measured total porosity (which is physically impossible), then the water-filled porosity is set equal to the total porosity (and thus air-filled porosity is zero).

(4) The properties of sample GTB-01@5.5-6.0 are used as site-specific J&E model inputs.

Table 5. Johnson and Ettinger Model Input Data

Parameter	Units	Default	Site-specific
Lithology and Soil Properties			
General			
Average soil temperature, T_S	°C	22	20
Stratum A			
Thickness, h^A	cm	9	457
Dry bulk density, $\rho_b{}^A$	g/cm^3	1.66	1.79
Total porosity, n^A	cm^3/cm^3	0.375	0.335
Water-filled porosity, $\theta_w{}^A$	cm^3/cm^3	0.054	0.177
Stratum B			
Thickness, h^B	cm	10	0
Dry bulk density, $\rho_b{}^B$	g/cm^3	1.66	1.50
Total porosity, n^B	cm^3/cm^3	0.375	0.430
Water-filled porosity, $\theta_w{}^B$	cm^3/cm^3	0.054	0.150
Stratum C			
Thickness, h^C	cm	30	0
Dry bulk density, $\rho_b{}^C$	g/cm3	1.80	1.50
Total porosity, n^C	cm^3/cm^3	0.300	0.430
Water-filled porosity, $\theta_w{}^C$	cm^3/cm^3	0.150	0.150
Building Properties			
Depth below grade to bottom of enclosed space floor, L_F	cm	9	9
Enclosed space floor thickness, L_{crack}	cm	9	9
Enclosed space floor length, L_B	cm	1,000	1,000
Enclosed space floor width, W_B	cm	1,000	1,000
Enclosed space floor height, H_B	cm	244	244
Floor-wall seam crack width, w	cm	0.1	0.1
Indoor air exchange rate, ER	hr^{-1}	1.00	1.00
Average vapor flow rate into building, Q_{soil}	L/min	5	5
Source Characterization			
Chemical	none	varies	varies
Soil gas concentration, C_g	µg/m^3	1	1
Depth below grade to contamination, L_S	cm	49	305

Table 5. Johnson and Ettinger Model Input Data

Parameter	Units	Default	Site-specific

Notes:

(1) Site-specific input values are highlighted. All other input values are Cal/EPA OEHHA default values (Cal/EPA, 2005).

Table 6. Physicochemical Properties

Chemical	Enthalpy of Vaporization at the Normal Boiling Point (cal/mol)	Normal Boiling Point (K)	Critical Temperature (K)	Henry's Law Constant at Reference Temperature (atm·m3/mol)	Henry's Law Constant Reference Temperature (°C)	Diffusivity in Air (cm2/s)	Diffusivity in Water (cm2/s)
Acetone	6.96E+03	3.29E+02	5.08E+02	3.87E-05	2.50E+01	1.24E-01	1.14E-05
Butanone, 2-	7.48E+03	3.53E+02	5.37E+02	5.58E-05	2.50E+01	8.08E-02	9.80E-06
Chloroform	6.99E+03	3.34E+02	5.36E+02	3.66E-03	2.50E+01	1.04E-01	1.00E-05
Dichloroethane, 1,1-	6.90E+03	3.31E+02	5.23E+02	5.61E-03	2.50E+01	7.42E-02	1.05E-05
Dichloroethane, 1,2-	7.64E+03	3.57E+02	5.61E+02	9.77E-04	2.50E+01	1.04E-01	9.90E-06
Dichloroethene, 1,1-	6.25E+03	3.05E+02	5.76E+02	2.60E-02	2.50E+01	9.00E-02	1.04E-05
Dichloroethene, 1,2-, cis-	7.19E+03	3.34E+02	5.44E+02	4.07E-03	2.50E+01	7.36E-02	1.13E-05
Methylene chloride	6.71E+03	3.13E+02	5.10E+02	2.18E-03	2.50E+01	1.01E-01	1.17E-05
Tetrachloroethene	8.29E+03	3.94E+02	6.20E+02	1.84E-02	2.50E+01	7.20E-02	8.20E-06
Trichloroethane, 1,1,1-	7.14E+03	3.47E+02	5.45E+02	1.72E-02	2.50E+01	7.80E-02	8.80E-06
Trichloroethane, 1,1,2-	8.32E+03	3.86E+02	6.02E+02	9.11E-04	2.50E+01	7.80E-02	8.80E-06
Trichloroethene	7.51E+03	3.60E+02	5.44E+02	1.03E-02	2.50E+01	7.90E-02	9.10E-06
Trichlorofluoromethane	6.00E+03	2.97E+02	4.71E+02	9.68E-02	2.50E+01	8.70E-02	9.70E-06
Trichlorotrifluoroethane, 1,1,2-, 1,2,2-	6.46E+03	3.21E+02	4.87E+02	4.80E-01	2.50E+01	7.80E-02	8.20E-06

Notes:

(1) Source of physicochemical properties is USEPA Johnson and Ettinger Model (USEPA, 2004a; 2004b).

Table 7. Soil Gas-to-Indoor Air Transport Calculations (Johnson and Ettinger Advanced Soil Gas Model) – Default Evaluation

Chemical	Enthalpy of Vaporization at the Average Soil Temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's Law Constant at the Average Soil Temperature, H_{TS} (atm·m3/mol)	Henry's Law Constant at the Average Soil Temperature, H'_{TS} (unitless)	Stratum A Effective Diffusion Coefficient, D_{eff}^{A} (cm2/s)	Stratum B Effective Diffusion Coefficient, D_{eff}^{B} (cm2/s)	Stratum C Effective Diffusion Coefficient, D_{eff}^{C} (cm2/s)	Source-building Separation, L_T (cm)	Total Effective Diffusivity, D_{eff}^{T} (cm2/s)	Average Vapor Flow Rate into Building, Q_{soil} (cm3/s)	Area of Enclosed Space below Grade, A_B (cm2)	Building Ventilation Rate, $Q_{building}$ (cm3/s)	Infinite Source Indoor Attenuation Coefficient, α (unitless)
Acetone	7.41E+03	3.41E-05	1.41E-03	2.00E-02	2.00E-02	2.63E-03	40	3.36E-03	8.33E+01	1.04E+06	6.78E+04	6.28E-04
Butanone, 2-	8.27E+03	4.84E-05	2.00E-03	1.30E-02	1.30E-02	1.71E-03	40	2.18E-03	8.33E+01	1.04E+06	6.78E+04	4.97E-04
Chloroform	7.43E+03	3.22E-03	1.33E-01	1.67E-02	1.67E-02	2.07E-03	40	2.66E-03	8.33E+01	1.04E+06	6.78E+04	5.56E-04
Dichloroethane, 1,1-	7.32E+03	4.94E-03	2.04E-01	1.19E-02	1.19E-02	1.48E-03	40	1.89E-03	8.33E+01	1.04E+06	6.78E+04	4.56E-04
Dichloroethane, 1,2-	8.39E+03	8.46E-04	3.49E-02	1.67E-02	1.67E-02	2.08E-03	40	2.66E-03	8.33E+01	1.04E+06	6.78E+04	5.56E-04
Dichloroethene, 1,1-	6.31E+03	2.34E-02	9.65E-01	1.45E-02	1.45E-02	1.79E-03	40	2.30E-03	8.33E+01	1.04E+06	6.78E+04	5.12E-04
Dichloroethene, 1,2-, cis-	7.61E+03	3.57E-03	1.47E-01	1.19E-02	1.19E-02	1.47E-03	40	1.88E-03	8.33E+01	1.04E+06	6.78E+04	4.53E-04
Methylene chloride	6.91E+03	1.94E-03	8.01E-02	1.63E-02	1.63E-02	2.02E-03	40	2.58E-03	8.33E+01	1.04E+06	6.78E+04	5.47E-04
Tetrachloroethene	9.43E+03	1.56E-02	6.45E-01	1.16E-02	1.16E-02	1.43E-03	40	1.84E-03	8.33E+01	1.04E+06	6.78E+04	4.47E-04
Trichloroethane, 1,1,1-	7.75E+03	1.50E-02	6.20E-01	1.26E-02	1.26E-02	1.55E-03	40	1.99E-03	8.33E+01	1.04E+06	6.78E+04	4.70E-04
Trichloroethane, 1,1,2-	9.44E+03	7.75E-04	3.20E-02	1.26E-02	1.26E-02	1.56E-03	40	2.00E-03	8.33E+01	1.04E+06	6.78E+04	4.71E-04
Trichloroethene	8.41E+03	8.89E-03	3.67E-01	1.27E-02	1.27E-02	1.57E-03	40	2.02E-03	8.33E+01	1.04E+06	6.78E+04	4.74E-04
Trichlorofluoromethane	6.02E+03	8.73E-02	3.60E+00	1.40E-02	1.40E-02	1.73E-03	40	2.22E-03	8.33E+01	1.04E+06	6.78E+04	5.02E-04
Trichlorotrifluoroethane, 1,1,2-, 1,2,2-	6.81E+03	4.27E-01	1.76E+01	1.26E-02	1.26E-02	1.55E-03	40	1.99E-03	8.33E+01	1.04E+06	6.78E+04	4.70E-04

Notes:

(1) Transport calculations are consistent with USEPA Johnson and Ettinger Advanced Soil Gas Model (USEPA, 2004a' 2004b).

Table 8. Soil Gas-to-Indoor Air Transport Calculations (Johnson and Ettinger Advanced Soil Gas Model) – Site-specific Evaluation

Chemical	Enthalpy of Vaporization at the Average Soil Temperature, $\Delta H_{V,TS}$ (cal/mol)	Henry's Law Constant at the Average Soil Temperature, H_{TS} (atm·m3/mol)	Henry's Law Constant at the Average Soil Temperature, H'_{TS} (unitless)	Stratum A Effective Diffusion Coefficient, D_{eff}^A (cm2/s)	Stratum B Effective Diffusion Coefficient, D_{eff}^B (cm2/s)	Stratum C Effective Diffusion Coefficient, D_{eff}^C (cm2/s)	Source-building Separation, L_T (cm)	Total Effective Diffusivity, D_{eff}^T (cm2/s)	Average Vapor Flow Rate into Building, Q_{soil} (cm3/s)	Area of Enclosed Space below Grade, A_B (cm2)	Building Ventilation Rate, $Q_{building}$ (cm3/s)	Infinite Source Indoor Attenuation Coefficient, α (unitless)
Acetone	7.43E+03	3.12E-05	1.30E-03	2.60E-03	9.72E-03	9.72E-03	296	2.60E-03	8.33E+01	1.04E+06	6.78E+04	1.21E-04
Butanone, 2-	8.29E+03	4.39E-05	1.83E-03	1.68E-03	6.33E-03	6.33E-03	296	1.68E-03	8.33E+01	1.04E+06	6.78E+04	8.13E-05
Chloroform	7.45E+03	2.95E-03	1.23E-01	1.98E-03	8.08E-03	8.08E-03	296	1.98E-03	8.33E+01	1.04E+06	6.78E+04	9.44E-05
Dichloroethane, 1,1-	7.34E+03	4.54E-03	1.89E-01	1.41E-03	5.76E-03	5.76E-03	296	1.41E-03	8.33E+01	1.04E+06	6.78E+04	6.88E-05
Dichloroethane, 1,2-	8.41E+03	7.67E-04	3.19E-02	1.98E-03	8.08E-03	8.08E-03	296	1.98E-03	8.33E+01	1.04E+06	6.78E+04	9.47E-05
Dichloroethene, 1,1-	6.33E+03	2.17E-02	9.02E-01	1.71E-03	6.99E-03	6.99E-03	296	1.71E-03	8.33E+01	1.04E+06	6.78E+04	8.25E-05
Dichloroethene, 1,2-, cis-	7.63E+03	3.27E-03	1.36E-01	1.40E-03	5.72E-03	5.72E-03	296	1.40E-03	8.33E+01	1.04E+06	6.78E+04	6.84E-05
Methylene chloride	6.93E+03	1.79E-03	7.44E-02	1.92E-03	7.85E-03	7.85E-03	296	1.92E-03	8.33E+01	1.04E+06	6.78E+04	9.20E-05
Tetrachloroethene	9.45E+03	1.40E-02	5.81E-01	1.37E-03	5.59E-03	5.59E-03	296	1.37E-03	8.33E+01	1.04E+06	6.78E+04	6.69E-05
Trichloroethane, 1,1,1-	7.78E+03	1.37E-02	5.70E-01	1.48E-03	6.06E-03	6.06E-03	296	1.48E-03	8.33E+01	1.04E+06	6.78E+04	7.21E-05
Trichloroethane, 1,1,2-	9.46E+03	6.94E-04	2.88E-02	1.49E-03	6.06E-03	6.06E-03	296	1.49E-03	8.33E+01	1.04E+06	6.78E+04	7.25E-05
Trichloroethene	8.43E+03	8.06E-03	3.35E-01	1.50E-03	6.14E-03	6.14E-03	296	1.50E-03	8.33E+01	1.04E+06	6.78E+04	7.30E-05
Trichlorofluoromethane	6.04E+03	8.13E-02	3.38E+00	1.65E-03	6.76E-03	6.76E-03	296	1.65E-03	8.33E+01	1.04E+06	6.78E+04	7.99E-05
Trichlorotrifluoroethane, 1,1,2-, 1,2,2-	6.84E+03	3.94E-01	1.64E+01	1.48E-03	6.06E-03	6.06E-03	296	1.48E-03	8.33E+01	1.04E+06	6.78E+04	7.21E-05

Notes:

(1) Transport calculations are consistent with USEPA Johnson and Ettinger Advanced Soil Gas Model (USEPA, 2004a' 2004b).

Table 9. Soil Gas Risk-based Screening Levels – Default Evaluation

Chemical	Indoor Air RBSL		Attenuation Factor	Soil Gas RBSL	
	Cancer Effects ($\mu g/m^3$)	Noncancer Effects ($\mu g/m^3$)		Cancer Effects ($\mu g/m^3$)	Noncancer Effects ($\mu g/m^3$)
Acetone	nc	1.4E+05	6.3E-04	nc	2.2E+08
Butanone, 2-	nc	2.2E+04	5.0E-04	nc	4.4E+07
Chloroform	5.3E-01	4.3E+02	5.6E-04	9.6E+02	7.7E+05
Dichloroethane, 1,1-	7.7E+00	3.1E+03	4.6E-04	1.7E+04	6.7E+06
Dichloroethane, 1,2-	4.7E-01	3.1E+01	5.6E-04	8.5E+02	5.5E+04
Dichloroethene, 1,1-	nc	8.8E+02	5.1E-04	nc	1.7E+06
Dichloroethene, 1,2-, cis-	nc	3.1E+01	4.5E-04	nc	6.8E+04
Methylene chloride	2.6E+01	4.4E+03	5.5E-04	4.8E+04	8.0E+06
Tetrachloroethene	2.1E+00	1.2E+03	4.5E-04	4.7E+03	2.6E+06
Trichloroethane, 1,1,1-	nc	2.2E+04	4.7E-04	nc	4.7E+07
Trichloroethane, 1,1,2-	7.7E-01	8.8E-01	4.7E-04	1.6E+03	1.9E+03
Trichloroethene	2.6E+00	8.8E+00	4.7E-04	5.4E+03	1.8E+04
Trichlorofluoromethane	nc	3.1E+03	5.0E-04	nc	6.1E+06
Trichlorotrifluoroethane, 1,1,2-, 1,2,2	nc	1.3E+05	4.7E-04	nc	2.8E+08

Notes:

(1) Cancer- and noncancer-based screening levels are based on target risk of 1E-06 and target hazard quotient of 1.0, respectively.

(2) "nc" indicates chemical is a noncarcinogen.

Table 10. Soil Gas Risk-based Screening Levels – Site-specific Evaluation

Chemical	Indoor Air RBSL		Attenuation Factor	Soil Gas RBSL	
	Cancer Effects ($\mu g/m^3$)	Noncancer Effects ($\mu g/m^3$)		Cancer Effects ($\mu g/m^3$)	Noncancer Effects ($\mu g/m^3$)
Acetone	nc	1.4E+05	1.2E-04	nc	1.1E+09
Butanone, 2-	nc	2.2E+04	8.1E-05	nc	2.7E+08
Chloroform	5.3E-01	4.3E+02	9.4E-05	5.6E+03	4.5E+06
Dichloroethane, 1,1-	7.7E+00	3.1E+03	6.9E-05	1.1E+05	4.5E+07
Dichloroethane, 1,2-	4.7E-01	3.1E+01	9.5E-05	5.0E+03	3.2E+05
Dichloroethene, 1,1-	nc	8.8E+02	8.2E-05	nc	1.1E+07
Dichloroethene, 1,2-, cis-	nc	3.1E+01	6.8E-05	nc	4.5E+05
Methylene chloride	2.6E+01	4.4E+03	9.2E-05	2.8E+05	4.8E+07
Tetrachloroethene	2.1E+00	1.2E+03	6.7E-05	3.1E+04	1.8E+07
Trichloroethane, 1,1,1-	nc	2.2E+04	7.2E-05	nc	3.0E+08
Trichloroethane, 1,1,2-	7.7E-01	8.8E-01	7.2E-05	1.1E+04	1.2E+04
Trichloroethene	2.6E+00	8.8E+00	7.3E-05	3.5E+04	1.2E+05
Trichlorofluoromethane	nc	3.1E+03	8.0E-05	nc	3.8E+07
Trichlorotrifluoroethane, 1,1,2-, 1,2,2	nc	1.3E+05	7.2E-05	nc	1.8E+09

Notes:

(1) Cancer- and noncancer-based screening levels are based on target risk of 1E-06 and target hazard quotient of 1.0, respectively.

(2) "nc" indicates chemical is a noncarcinogen.

Table 11. Vapor Intrusion Cumulative Risk and Hazard – Default Evaluation

Chemical	Soil Gas RBSL		VSP-061611-SVE-1			VSP-061611-SVE-2S			VSP-061611-SVE-3S			VSP-061611-SVE-4S			VSP-061611-SVE-5S		
	Cancer (µg/m3)	Noncancer (µg/m3)	Conc. (µg/m3)	Risk	Hazard	Conc. (µg/m3)	Risk	Hazard	Conc. (µg/m3)	Risk	Hazard	Conc. (µg/m3)	Risk	Hazard	Conc. (µg/m3)	Risk	Hazard
Acetone	nc	2.16E+08	84	nc	3.9E-07	32	nc	1.5E-07	22	nc	1.0E-07	25	nc	1.2E-07	36	nc	1.7E-07
Butanone, 2-	nc	4.41E+07	15	nc	3.4E-07	ND	nc	0.0E+00	ND	nc	0.0E+00	ND	nc	0.0E+00	ND	nc	0.0E+00
Chloroform	9.59E+02	7.72E+05	20	2.1E-08	2.6E-05	32	3.3E-08	4.1E-05	6.6	6.9E-09	8.5E-06	10	1.0E-08	1.3E-05	11	1.1E-08	1.4E-05
Dichloroethane, 1,1-	1.68E+04	6.73E+06	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00	4.8	2.9E-10	7.1E-07
Dichloroethane, 1,2-	8.48E+02	5.51E+04	ND	0.0E+00	0.0E+00	20	2.4E-08	3.6E-04	13	1.5E-08	2.4E-04	8.4	9.9E-09	1.5E-04	ND	0.0E+00	0.0E+00
Dichloroethene, 1,1-	nc	1.71E+06	430	nc	2.5E-04	22	nc	1.3E-05	82	nc	4.8E-05	6.9	nc	4.0E-06	13	nc	7.6E-06
Dichloroethene, 1,2-, cis-	nc	6.76E+04	ND	nc	0.0E+00	ND	nc	0.0E+00	5.8	nc	8.6E-05	ND	nc	0.0E+00	18	nc	2.7E-04
Methylene chloride	4.77E+04	8.00E+06	4.9	1.0E-10	6.1E-07	12	2.5E-10	1.5E-06	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00
Tetrachloroethene	4.65E+03	2.65E+06	2,400	5.2E-07	9.1E-04	1,500	3.2E-07	5.7E-04	1,500	3.2E-07	5.7E-04	1,100	2.4E-07	4.2E-04	1,400	3.0E-07	5.3E-04
Trichloroethane, 1,1,1-	nc	4.66E+07	ND	nc	0.0E+00	ND	nc	0.0E+00	ND	nc	0.0E+00	14	nc	3.0E-07	20	nc	4.3E-07
Trichloroethane, 1,1,2-	1.63E+03	1.86E+03	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00	6.4	3.9E-09	3.4E-03	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00
Trichloroethene	5.39E+03	1.85E+04	900	1.7E-07	4.9E-02	340	6.3E-08	1.8E-02	500	9.3E-08	2.7E-02	120	2.2E-08	6.5E-03	170	3.2E-08	9.2E-03
Trichlorofluoromethane	nc	6.11E+06	ND	nc	0.0E+00	ND	nc	0.0E+00	43	nc	7.0E-06	ND	nc	0.0E+00	8.7	nc	1.4E-06
Trichlorotrifluoroethane, 1,1,2-, 1,2,2-	nc	2.80E+08	150	nc	5.4E-07	39	nc	1.4E-07	73	nc	2.6E-07	15	nc	5.4E-08	13	nc	4.6E-08
Cumulative (multi-chemical)				**7.0E-07**	**5.0E-02**		**4.4E-07**	**1.9E-02**		**4.4E-07**	**3.1E-02**		**2.8E-07**	**7.1E-03**		**3.4E-07**	**1.0E-02**

Notes:

(1) The cancer risk or noncancer hazard associated with each detected concentration is calculated by ratioing the result to the cancer- or noncancer-based screening level, and multiplying by the target risk (1E-06) or target hazard quotient (1.0).

(2) Non-detect results are assumed to be zero.

Table 11. Vapor Intrusion Cumulative Risk and Hazard – Default Evaluation

Chemical	Soil Gas RBSL		VSP-061611-SVE-6S			VSP-061611-SVE-7S			VSP-061611-SVE-7S-DUP		
	Cancer (µg/m3)	Noncancer (µg/m3)	Conc. (µg/m3)	Risk	Hazard	Conc. (µg/m3)	Risk	Hazard	Conc. (µg/m3)	Risk	Hazard
Acetone	nc	2.16E+08	15	nc	6.9E-08	23	nc	1.1E-07	20	nc	9.3E-08
Butanone, 2-	nc	4.41E+07	ND	nc	0.0E+00	ND	nc	0.0E+00	ND	nc	0.0E+00
Chloroform	9.59E+02	7.72E+05	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00
Dichloroethane, 1,1-	1.68E+04	6.73E+06	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00
Dichloroethane, 1,2-	8.48E+02	5.51E+04	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00
Dichloroethene, 1,1-	nc	1.71E+06	18	nc	1.1E-05	38	nc	2.2E-05	38	nc	2.2E-05
Dichloroethene, 1,2-, cis-	nc	6.76E+04	ND	nc	0.0E+00	ND	nc	0.0E+00	ND	nc	0.0E+00
Methylene chloride	4.77E+04	8.00E+06	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00
Tetrachloroethene	4.65E+03	2.65E+06	370	8.0E-08	1.4E-04	1,000	2.1E-07	3.8E-04	970	2.1E-07	3.7E-04
Trichloroethane, 1,1,1-	nc	4.66E+07	ND	nc	0.0E+00	ND	nc	0.0E+00	ND	nc	0.0E+00
Trichloroethane, 1,1,2-	1.63E+03	1.86E+03	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00
Trichloroethene	5.39E+03	1.85E+04	59	1.1E-08	3.2E-03	160	3.0E-08	8.7E-03	150	2.8E-08	8.1E-03
Trichlorofluoromethane	nc	6.11E+06	ND	nc	0.0E+00	ND	nc	0.0E+00	ND	nc	0.0E+00
Trichlorotrifluoroethane, 1,1,2-, 1,2,2-	nc	2.80E+08	14	nc	5.0E-08	33	nc	1.2E-07	30	nc	1.1E-07
Cumulative (multi-chemical)				9.0E-08	3.3E-03		2.4E-07	9.1E-03		2.4E-07	8.5E-03

Notes:

(1) The cancer risk or noncancer hazard associated with each detected concentration is calculated by ratioing the result to the cancer- or noncancer-based screening level, and multiplying by the target risk (1E-06) or target hazard quotient (1.0).

(2) Non-detect results are assumed to be zero.

Table 12. Vapor Intrusion Cumulative Risk and Hazard – Site-specific Evaluation

	Soil Gas RBSL		VSP-061611-SVE-1			VSP-061611-SVE-2S			VSP-061611-SVE-3S			VSP-061611-SVE-4S			VSP-061611-SVE-5S		
Chemical	Cancer (µg/m3)	Noncancer (µg/m3)	Conc. (µg/m3)	Risk	Hazard	Conc. (µg/m3)	Risk	Hazard	Conc. (µg/m3)	Risk	Hazard	Conc. (µg/m3)	Risk	Hazard	Conc. (µg/m3)	Risk	Hazard
Acetone	nc	1.12E+09	84	nc	7.5E-08	32	nc	2.9E-08	22	nc	2.0E-08	25	nc	2.2E-08	36	nc	3.2E-08
Butanone, 2-	nc	2.69E+08	15	nc	5.6E-08	ND	nc	0.0E+00	ND	nc	0.0E+00	ND	nc	0.0E+00	ND	nc	0.0E+00
Chloroform	5.65E+03	4.55E+06	20	3.5E-09	4.4E-06	32	5.7E-09	7.0E-06	6.6	1.2E-09	1.5E-06	10	1.8E-09	2.2E-06	11	1.9E-09	2.4E-06
Dichloroethane, 1,1-	1.11E+05	4.45E+07	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00	4.8	4.3E-11	1.1E-07
Dichloroethane, 1,2-	4.98E+03	3.24E+05	ND	0.0E+00	0.0E+00	20	4.0E-09	6.2E-05	13	2.6E-09	4.0E-05	8.4	1.7E-09	2.6E-05	ND	0.0E+00	0.0E+00
Dichloroethene, 1,1-	nc	1.06E+07	430	nc	4.0E-05	22	nc	2.1E-06	82	nc	7.7E-06	6.9	nc	6.5E-07	13	nc	1.2E-06
Dichloroethene, 1,2-, cis-	nc	4.49E+05	ND	nc	0.0E+00	ND	nc	0.0E+00	5.8	nc	1.3E-05	ND	nc	0.0E+00	18	nc	4.0E-05
Methylene chloride	2.84E+05	4.76E+07	4.9	1.7E-11	1.0E-07	12	4.2E-11	2.5E-07	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00
Tetrachloroethene	3.11E+04	1.77E+07	2,400	7.7E-08	1.4E-04	1,500	4.8E-08	8.5E-05	1,500	4.8E-08	8.5E-05	1,100	3.5E-08	6.2E-05	1,400	4.5E-08	7.9E-05
Trichloroethane, 1,1,1-	nc	3.04E+08	ND	nc	0.0E+00	ND	nc	0.0E+00	ND	nc	0.0E+00	14	nc	4.6E-08	20	nc	6.6E-08
Trichloroethane, 1,1,2-	1.06E+04	1.21E+04	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00	6.4	6.1E-10	5.3E-04	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00
Trichloroethene	3.50E+04	1.20E+05	900	2.6E-08	7.5E-03	340	9.7E-09	2.8E-03	500	1.4E-08	4.2E-03	120	3.4E-09	1.0E-03	170	4.9E-09	1.4E-03
Trichlorofluoromethane	nc	3.84E+07	ND	nc	0.0E+00	ND	nc	0.0E+00	43	nc	1.1E-06	ND	nc	0.0E+00	8.7	nc	2.3E-07
Trichlorotrifluoroethane, 1,1,2-, 1,2,2-	nc	1.82E+09	150	nc	8.2E-08	39	nc	2.1E-08	73	nc	4.0E-08	15	nc	8.2E-09	13	nc	7.1E-09
Cumulative (multi-chemical)				**1.1E-07**	**7.7E-03**		**6.8E-08**	**3.0E-03**		**6.7E-08**	**4.8E-03**		**4.2E-08**	**1.1E-03**		**5.2E-08**	**1.5E-03**

Notes:

(1) The cancer risk or noncancer hazard associated with each detected concentration is calculated by ratioing the result to the cancer- or noncancer-based screening level, and multiplying by the target risk (1E-06) or target hazard quotient (1.0).

(2) Non-detect results are assumed to be zero.

Table 12. Vapor Intrusion Cumulative Risk and Hazard – Site-specific Evaluation

Chemical	Soil Gas RBSL		VSP-061611-SVE-6S			VSP-061611-SVE-7S			VSP-061611-SVE-7S-DUP		
	Cancer (µg/m3)	Noncancer (µg/m3)	Conc. (µg/m3)	Risk	Hazard	Conc. (µg/m3)	Risk	Hazard	Conc. (µg/m3)	Risk	Hazard
Acetone	nc	1.12E+09	15	nc	1.3E-08	23	nc	2.1E-08	20	nc	1.8E-08
Butanone, 2-	nc	2.69E+08	ND	nc	0.0E+00	ND	nc	0.0E+00	ND	nc	0.0E+00
Chloroform	5.65E+03	4.55E+06	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00
Dichloroethane, 1,1-	1.11E+05	4.45E+07	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00
Dichloroethane, 1,2-	4.98E+03	3.24E+05	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00
Dichloroethene, 1,1-	nc	1.06E+07	18	nc	1.7E-06	38	nc	3.6E-06	38	nc	3.6E-06
Dichloroethene, 1,2-, cis-	nc	4.49E+05	ND	nc	0.0E+00	ND	nc	0.0E+00	ND	nc	0.0E+00
Methylene chloride	2.84E+05	4.76E+07	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00
Tetrachloroethene	3.11E+04	1.77E+07	370	1.2E-08	2.1E-05	1,000	3.2E-08	5.7E-05	970	3.1E-08	5.5E-05
Trichloroethane, 1,1,1-	nc	3.04E+08	ND	nc	0.0E+00	ND	nc	0.0E+00	ND	nc	0.0E+00
Trichloroethane, 1,1,2-	1.06E+04	1.21E+04	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00
Trichloroethene	3.50E+04	1.20E+05	59	1.7E-09	4.9E-04	160	4.6E-09	1.3E-03	150	4.3E-09	1.2E-03
Trichlorofluoromethane	nc	3.84E+07	ND	nc	0.0E+00	ND	nc	0.0E+00	ND	nc	0.0E+00
Trichlorotrifluoroethane, 1,1,2-, 1,2,2-	nc	1.82E+09	14	nc	7.7E-09	33	nc	1.8E-08	30	nc	1.6E-08
Cumulative (multi-chemical)				**1.4E-08**	**5.1E-04**		**3.7E-08**	**1.4E-03**		**3.5E-08**	**1.3E-03**

Notes:

(1) The cancer risk or noncancer hazard associated with each detected concentration is calculated by ratioing the result to the cancer- or noncancer-based screening level, and multiplying by the target risk (1E-06) or target hazard quotient (1.0).

(2) Non-detect results are assumed to be zero.

Table 13. Summary of Vapor Intrusion Cumulative Risk and Hazard

	Default Evaluation		Site-specific Evaluation	
Soil Gas Sample	Cancer Risk	Noncancer Hazard Index	Cancer Risk	Noncancer Hazard Index
VSP-061611-SVE-1	7.0E-07	5.0E-02	1.1E-07	7.7E-03
VSP-061611-SVE-2S	4.4E-07	1.9E-02	6.8E-08	3.0E-03
VSP-061611-SVE-3S	4.4E-07	3.1E-02	6.7E-08	4.8E-03
VSP-061611-SVE-4S	2.8E-07	7.1E-03	4.2E-08	1.1E-03
VSP-061611-SVE-5S	3.4E-07	1.0E-02	5.2E-08	1.5E-03
VSP-061611-SVE-6S	9.0E-08	3.3E-03	1.4E-08	5.1E-04
VSP-061611-SVE-7S	2.4E-07	9.1E-03	3.7E-08	1.4E-03
VSP-061611-SVE-7S-DUP	2.4E-07	8.5E-03	3.5E-08	1.3E-03

Table 14. Calculation of Dispersion Factor

Symbol	Name	Value	Units	Note
A_{source}	Area of emissions source	0.5	acre	Most conservative
A	Empirical dispersion coefficient	10.2871	–	Zone 3 / Phoenix, AZ (1)
B	Empirical dispersion coefficient	18.7124	–	Zone 3 / Phoenix, AZ (1)
C	Empirical dispersion coefficient	212.2704	–	Zone 3 / Phoenix, AZ (1)
$(Q/C)_{vol}$	"Q over C" dispersion factor	60.6	$g/m^2/s$ per kg/m^3	(1)

Notes:

(1) Reference: USEPA soil screening guidance (USEPA, 1996; 2002)

Table 15. Soil Gas-to-Outdoor Air Transport Calculations – Default Evaluation

Chemical	Enthalpy of Vaporization at the Average Soil Temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's Law Constant at the Average Soil Temperature, H_{TS} (atm·m3/mol)	Henry's Law Constant at the Average Soil Temperature, H'_{TS} (unitless)	Stratum A Effective Diffusion Coefficient, D_{eff}^{A} (cm2/s)	Stratum B Effective Diffusion Coefficient, D_{eff}^{B} (cm2/s)	Stratum C Effective Diffusion Coefficient, D_{eff}^{C} (cm2/s)	Total Effective Diffusivity, D_{eff}^{T} (cm2/s)	Normalized Steady-state Flux to Outdoor Air ($g/m^2/s$ per $\mu g/m^3$)	Q-over-C Dispersion Factor g/m2/s per kg/m3	Normalized Outdoor Air Conc. ($\mu g/m^3$ per $\mu g/m^3$)
Acetone	7.41E+03	3.41E-05	1.41E-03	2.00E-02	2.00E-02	2.63E-03	3.97E-03	8.10E-13	6.06E+01	1.34E-05
Butanone, 2-	8.27E+03	4.84E-05	2.00E-03	1.30E-02	1.30E-02	1.71E-03	2.58E-03	5.26E-13	6.06E+01	8.67E-06
Chloroform	7.43E+03	3.22E-03	1.33E-01	1.67E-02	1.67E-02	2.07E-03	3.14E-03	6.41E-13	6.06E+01	1.06E-05
Dichloroethane, 1,1-	7.32E+03	4.94E-03	2.04E-01	1.19E-02	1.19E-02	1.48E-03	2.24E-03	4.57E-13	6.06E+01	7.55E-06
Dichloroethane, 1,2-	8.39E+03	8.46E-04	3.49E-02	1.67E-02	1.67E-02	2.08E-03	3.15E-03	6.42E-13	6.06E+01	1.06E-05
Dichloroethene, 1,1-	6.31E+03	2.34E-02	9.65E-01	1.45E-02	1.45E-02	1.79E-03	2.72E-03	5.54E-13	6.06E+01	9.15E-06
Dichloroethene, 1,2-, cis-	7.61E+03	3.57E-03	1.47E-01	1.19E-02	1.19E-02	1.47E-03	2.22E-03	4.54E-13	6.06E+01	7.49E-06
Methylene chloride	6.91E+03	1.94E-03	8.01E-02	1.63E-02	1.63E-02	2.02E-03	3.05E-03	6.23E-13	6.06E+01	1.03E-05
Tetrachloroethene	9.43E+03	1.56E-02	6.45E-01	1.16E-02	1.16E-02	1.43E-03	2.17E-03	4.44E-13	6.06E+01	7.32E-06
Trichloroethane, 1,1,1-	7.75E+03	1.50E-02	6.20E-01	1.26E-02	1.26E-02	1.55E-03	2.35E-03	4.80E-13	6.06E+01	7.93E-06
Trichloroethane, 1,1,2-	9.44E+03	7.75E-04	3.20E-02	1.26E-02	1.26E-02	1.56E-03	2.36E-03	4.82E-13	6.06E+01	7.95E-06
Trichloroethene	8.41E+03	8.89E-03	3.67E-01	1.27E-02	1.27E-02	1.57E-03	2.38E-03	4.87E-13	6.06E+01	8.03E-06
Trichlorofluoromethane	6.02E+03	8.73E-02	3.60E+00	1.40E-02	1.40E-02	1.73E-03	2.63E-03	5.36E-13	6.06E+01	8.84E-06
Trichlorotrifluoroethane, 1,1,2-, 1,2,2-	6.81E+03	4.27E-01	1.76E+01	1.26E-02	1.26E-02	1.55E-03	2.35E-03	4.80E-13	6.06E+01	7.93E-06

Notes:

(1) Transport calculations are consistent with USEPA Johnson and Ettinger Advanced Soil Gas Model (USEPA, 2004a' 2004b).

Table 16. Soil Gas-to-Outdoor Air Transport Calculations – Site-specific Evaluation

Chemical	Enthalpy of Vaporization at the Average Soil Temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's Law Constant at the Average Soil Temperature, H_{TS} (atm·m3/mol)	Henry's Law Constant at the Average Soil Temperature, H'_{TS} (unitless)	Stratum A Effective Diffusion Coefficient, D_{eff}^{A} (cm2/s)	Stratum B Effective Diffusion Coefficient, D_{eff}^{B} (cm2/s)	Stratum C Effective Diffusion Coefficient, D_{eff}^{C} (cm2/s)	Total Effective Diffusivity, D_{eff}^{T} (cm2/s)	Normalized Steady-state Flux to Outdoor Air ($g/m^2/s$ per $\mu g/m^3$)	Q-over-C Dispersion Factor g/m2/s per kg/m3	Normalized Outdoor Air Conc. ($\mu g/m^3$ per $\mu g/m^3$)
Acetone	7.43E+03	3.12E-05	1.30E-03	2.60E-03	9.72E-03	9.72E-03	2.60E-03	8.53E-14	6.06E+01	1.41E-06
Butanone, 2-	8.29E+03	4.39E-05	1.83E-03	1.68E-03	6.33E-03	6.33E-03	1.68E-03	5.53E-14	6.06E+01	9.12E-07
Chloroform	7.45E+03	2.95E-03	1.23E-01	1.98E-03	8.08E-03	8.08E-03	1.98E-03	6.49E-14	6.06E+01	1.07E-06
Dichloroethane, 1,1-	7.34E+03	4.54E-03	1.89E-01	1.41E-03	5.76E-03	5.76E-03	1.41E-03	4.63E-14	6.06E+01	7.64E-07
Dichloroethane, 1,2-	8.41E+03	7.67E-04	3.19E-02	1.98E-03	8.08E-03	8.08E-03	1.98E-03	6.51E-14	6.06E+01	1.07E-06
Dichloroethene, 1,1-	6.33E+03	2.17E-02	9.02E-01	1.71E-03	6.99E-03	6.99E-03	1.71E-03	5.61E-14	6.06E+01	9.26E-07
Dichloroethene, 1,2-, cis-	7.63E+03	3.27E-03	1.36E-01	1.40E-03	5.72E-03	5.72E-03	1.40E-03	4.60E-14	6.06E+01	7.58E-07
Methylene chloride	6.93E+03	1.79E-03	7.44E-02	1.92E-03	7.85E-03	7.85E-03	1.92E-03	6.31E-14	6.06E+01	1.04E-06
Tetrachloroethene	9.45E+03	1.40E-02	5.81E-01	1.37E-03	5.59E-03	5.59E-03	1.37E-03	4.49E-14	6.06E+01	7.41E-07
Trichloroethane, 1,1,1-	7.78E+03	1.37E-02	5.70E-01	1.48E-03	6.06E-03	6.06E-03	1.48E-03	4.86E-14	6.06E+01	8.03E-07
Trichloroethane, 1,1,2-	9.46E+03	6.94E-04	2.88E-02	1.49E-03	6.06E-03	6.06E-03	1.49E-03	4.89E-14	6.06E+01	8.07E-07
Trichloroethene	8.43E+03	8.06E-03	3.35E-01	1.50E-03	6.14E-03	6.14E-03	1.50E-03	4.93E-14	6.06E+01	8.13E-07
Trichlorofluoromethane	6.04E+03	8.13E-02	3.38E+00	1.65E-03	6.76E-03	6.76E-03	1.65E-03	5.42E-14	6.06E+01	8.95E-07
Trichlorotrifluoroethane, 1,1,2-, 1,2,2-	6.84E+03	3.94E-01	1.64E+01	1.48E-03	6.06E-03	6.06E-03	1.48E-03	4.86E-14	6.06E+01	8.02E-07

Notes:

(1) Transport calculations are consistent with USEPA Johnson and Ettinger Advanced Soil Gas Model (USEPA, 2004a' 2004b).

Table 17. Soil Gas-to-Outdoor Air Risk-based Screening Levels – Default Evaluation

Chemical	Indoor Air RBSL		Attenuation Factor	Soil Gas-to-Outdoor Air RBSL	
	Cancer Effects (μg/m^3)	Noncancer Effects (μg/m^3)		Cancer Effects (μg/m^3)	Noncancer Effects (μg/m^3)
Acetone	nc	1.4E+05	1.3E-05	nc	1.0E+10
Butanone, 2-	nc	2.2E+04	8.7E-06	nc	2.5E+09
Chloroform	5.3E-01	4.3E+02	1.1E-05	5.0E+04	4.1E+07
Dichloroethane, 1,1-	7.7E+00	3.1E+03	7.5E-06	1.0E+06	4.1E+08
Dichloroethane, 1,2-	4.7E-01	3.1E+01	1.1E-05	4.5E+04	2.9E+06
Dichloroethene, 1,1-	nc	8.8E+02	9.1E-06	nc	9.6E+07
Dichloroethene, 1,2-, cis-	nc	3.1E+01	7.5E-06	nc	4.1E+06
Methylene chloride	2.6E+01	4.4E+03	1.0E-05	2.5E+06	4.3E+08
Tetrachloroethene	2.1E+00	1.2E+03	7.3E-06	2.8E+05	1.6E+08
Trichloroethane, 1,1,1-	nc	2.2E+04	7.9E-06	nc	2.8E+09
Trichloroethane, 1,1,2-	7.7E-01	8.8E-01	8.0E-06	9.6E+04	1.1E+05
Trichloroethene	2.6E+00	8.8E+00	8.0E-06	3.2E+05	1.1E+06
Trichlorofluoromethane	nc	3.1E+03	8.8E-06	nc	3.5E+08
Trichlorotrifluoroethane, 1,1,2-, 1,2,2	nc	1.3E+05	7.9E-06	nc	1.7E+10

Notes:

(1) Cancer- and noncancer-based screening levels are based on target risk of 1E-06 and target hazard quotient of 1.0, respectively.

(2) "nc" indicates chemical is a noncarcinogen.

Table 18. Soil Gas-to-Outdoor Air Risk-based Screening Levels – Site-specific Evaluation

Chemical	Indoor Air RBSL		Attenuation Factor	Soil Gas-to-Outdoor Air RBSL	
	Cancer Effects (µg/m³)	Noncancer Effects (µg/m³)		Cancer Effects (µg/m³)	Noncancer Effects (µg/m³)
Acetone	nc	1.4E+05	1.4E-06	nc	9.6E+10
Butanone, 2-	nc	2.2E+04	9.1E-07	nc	2.4E+10
Chloroform	5.3E-01	4.3E+02	1.1E-06	5.0E+05	4.0E+08
Dichloroethane, 1,1-	7.7E+00	3.1E+03	7.6E-07	1.0E+07	4.0E+09
Dichloroethane, 1,2-	4.7E-01	3.1E+01	1.1E-06	4.4E+05	2.9E+07
Dichloroethene, 1,1-	nc	8.8E+02	9.3E-07	nc	9.5E+08
Dichloroethene, 1,2-, cis-	nc	3.1E+01	7.6E-07	nc	4.0E+07
Methylene chloride	2.6E+01	4.4E+03	1.0E-06	2.5E+07	4.2E+09
Tetrachloroethene	2.1E+00	1.2E+03	7.4E-07	2.8E+06	1.6E+09
Trichloroethane, 1,1,1-	nc	2.2E+04	8.0E-07	nc	2.7E+10
Trichloroethane, 1,1,2-	7.7E-01	8.8E-01	8.1E-07	9.5E+05	1.1E+06
Trichloroethene	2.6E+00	8.8E+00	8.1E-07	3.1E+06	1.1E+07
Trichlorofluoromethane	nc	3.1E+03	8.9E-07	nc	3.4E+09
Trichlorotrifluoroethane, 1,1,2-, 1,2,2	nc	1.3E+05	8.0E-07	nc	1.6E+11

Notes:

(1) Cancer- and noncancer-based screening levels are based on target risk of 1E-06 and target hazard quotient of 1.0, respectively.

(2) "nc" indicates chemical is a noncarcinogen.

Table 19. Outdoor Air Cumulative Risk and Hazard – Default Evaluation

Chemical	Soil Gas-to-OA RBSL		VSP-061611-SVE-1			VSP-061611-SVE-2S			VSP-061611-SVE-3S			VSP-061611-SVE-4S			VSP-061611-SVE-5S		
	Cancer (µg/m3)	Noncancer (µg/m3)	Conc. (µg/m3)	Risk	Hazard	Conc. (µg/m3)	Risk	Hazard	Conc. (µg/m3)	Risk	Hazard	Conc. (µg/m3)	Risk	Hazard	Conc. (µg/m3)	Risk	Hazard
Acetone	nc	1.02E+10	84	nc	8.3E-09	32	nc	3.1E-09	22	nc	2.2E-09	25	nc	2.5E-09	36	nc	3.5E-09
Butanone, 2-	nc	2.53E+09	15	nc	5.9E-09	ND	nc	0.0E+00	ND	nc	0.0E+00	ND	nc	0.0E+00	ND	nc	0.0E+00
Chloroform	5.04E+04	4.06E+07	20	4.0E-10	4.9E-07	32	6.3E-10	7.9E-07	6.6	1.3E-10	1.6E-07	10	2.0E-10	2.5E-07	11	2.2E-10	2.7E-07
Dichloroethane, 1,1-	1.02E+06	4.06E+08	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00	4.8	4.7E-12	1.2E-08
Dichloroethane, 1,2-	4.45E+04	2.89E+06	ND	0.0E+00	0.0E+00	20	4.5E-10	6.9E-06	13	2.9E-10	4.5E-06	8.4	1.9E-10	2.9E-06	ND	0.0E+00	0.0E+00
Dichloroethene, 1,1-	nc	9.58E+07	430	nc	4.5E-06	22	nc	2.3E-07	82	nc	8.6E-07	6.9	nc	7.2E-08	13	nc	1.4E-07
Dichloroethene, 1,2-, cis-	nc	4.09E+06	ND	nc	0.0E+00	ND	nc	0.0E+00	5.8	nc	1.4E-06	ND	nc	0.0E+00	18	nc	4.4E-06
Methylene chloride	2.54E+06	4.26E+08	4.9	1.9E-12	1.1E-08	12	4.7E-12	2.8E-08	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00
Tetrachloroethene	2.84E+05	1.62E+08	2,400	8.5E-09	1.5E-05	1,500	5.3E-09	9.3E-06	1,500	5.3E-09	9.3E-06	1,100	3.9E-09	6.8E-06	1,400	4.9E-09	8.7E-06
Trichloroethane, 1,1,1-	nc	2.76E+09	ND	nc	0.0E+00	ND	nc	0.0E+00	ND	nc	0.0E+00	14	nc	5.1E-09	20	nc	7.2E-09
Trichloroethane, 1,1,2-	9.64E+04	1.10E+05	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00	6.4	6.6E-11	5.8E-05	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00
Trichloroethene	3.18E+05	1.09E+06	900	2.8E-09	8.3E-04	340	1.1E-09	3.1E-04	500	1.6E-09	4.6E-04	120	3.8E-10	1.1E-04	170	5.3E-10	1.6E-04
Trichlorofluoromethane	nc	3.47E+08	ND	nc	0.0E+00	ND	nc	0.0E+00	43	nc	1.2E-07	ND	nc	0.0E+00	8.7	nc	2.5E-08
Trichlorotrifluoroethane, 1,1,2-, 1,2,2-	nc	1.66E+10	150	nc	9.0E-09	39	nc	2.4E-09	73	nc	4.4E-09	15	nc	9.0E-10	13	nc	7.8E-10
Cumulative (multi-chemical)				1.2E-08	8.5E-04		7.4E-09	3.3E-04		7.3E-09	5.3E-04		4.6E-09	1.2E-04		5.7E-09	1.7E-04

Notes:

(1) The cancer risk or noncancer hazard associated with each detected concentration is calculated by ratioing the result to the cancer- or noncancer-based screening level, and multiplying by the target risk (1E-06) or target hazard quotient (1.0).

(2) Non-detect results are assumed to be zero.

Table 19. Outdoor Air Cumulative Risk and Hazard – Default Evaluation

Chemical	Soil Gas RBSL		VSP-061611-SVE-6S			VSP-061611-SVE-7S			VSP-061611-SVE-7S-DUP		
	Cancer (µg/m3)	Noncancer (µg/m3)	Conc. (µg/m3)	Risk	Hazard	Conc. (µg/m3)	Risk	Hazard	Conc. (µg/m3)	Risk	Hazard
Acetone	nc	1.02E+10	15	nc	1.5E-09	23	nc	2.3E-09	20	nc	2.0E-09
Butanone, 2-	nc	2.53E+09	ND	nc	0.0E+00	ND	nc	0.0E+00	ND	nc	0.0E+00
Chloroform	5.04E+04	4.06E+07	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00
Dichloroethane, 1,1-	1.02E+06	4.06E+08	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00
Dichloroethane, 1,2-	4.45E+04	2.89E+06	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00
Dichloroethene, 1,1-	nc	9.58E+07	18	nc	1.9E-07	38	nc	4.0E-07	38	nc	4.0E-07
Dichloroethene, 1,2-, cis-	nc	4.09E+06	ND	nc	0.0E+00	ND	nc	0.0E+00	ND	nc	0.0E+00
Methylene chloride	2.54E+06	4.26E+08	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00
Tetrachloroethene	2.84E+05	1.62E+08	370	1.3E-09	2.3E-06	1,000	3.5E-09	6.2E-06	970	3.4E-09	6.0E-06
Trichloroethane, 1,1,1-	nc	2.76E+09	ND	nc	0.0E+00	ND	nc	0.0E+00	ND	nc	0.0E+00
Trichloroethane, 1,1,2-	9.64E+04	1.10E+05	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00
Trichloroethene	3.18E+05	1.09E+06	59	1.9E-10	5.4E-05	160	5.0E-10	1.5E-04	150	4.7E-10	1.4E-04
Trichlorofluoromethane	nc	3.47E+08	ND	nc	0.0E+00	ND	nc	0.0E+00	ND	nc	0.0E+00
Trichlorotrifluoroethane, 1,1,2-, 1,2,2-	nc	1.66E+10	14	nc	8.4E-10	33	nc	2.0E-09	30	nc	1.8E-09
Cumulative (multi-chemical)				1.5E-09	5.7E-05		4.0E-09	1.5E-04		3.9E-09	1.4E-04

Notes:

(1) The cancer risk or noncancer hazard associated with each detected concentration is calculated by ratioing the result to the cancer- or noncancer-based screening level, and multiplying by the target risk (1E-06) or target hazard quotient (1.0).

(2) Non-detect results are assumed to be zero.

Table 20. Outdoor Air Cumulative Risk and Hazard – Site-specific Evaluation

Chemical	Soil Gas RBSL		VSP-061611-SVE-1			VSP-061611-SVE-2S			VSP-061611-SVE-3S			VSP-061611-SVE-4S			VSP-061611-SVE-5S		
	Cancer (µg/m3)	Noncancer (µg/m3)	Conc. (µg/m3)	Risk	Hazard	Conc. (µg/m3)	Risk	Hazard	Conc. (µg/m3)	Risk	Hazard	Conc. (µg/m3)	Risk	Hazard	Conc. (µg/m3)	Risk	Hazard
Acetone	nc	9.65E+10	84	nc	8.7E-10	32	nc	3.3E-10	22	nc	2.3E-10	25	nc	2.6E-10	36	nc	3.7E-10
Butanone, 2-	nc	2.40E+10	15	nc	6.2E-10	ND	nc	0.0E+00	ND	nc	0.0E+00	ND	nc	0.0E+00	ND	nc	0.0E+00
Chloroform	4.98E+05	4.01E+08	20	4.0E-11	5.0E-08	32	6.4E-11	8.0E-08	6.6	1.3E-11	1.6E-08	10	2.0E-11	2.5E-08	11	2.2E-11	2.7E-08
Dichloroethane, 1,1-	1.00E+07	4.01E+09	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00	4.8	4.8E-13	1.2E-09
Dichloroethane, 1,2-	4.39E+05	2.85E+07	ND	0.0E+00	0.0E+00	20	4.6E-11	7.0E-07	13	3.0E-11	4.6E-07	8.4	1.9E-11	2.9E-07	ND	0.0E+00	0.0E+00
Dichloroethene, 1,1-	nc	9.46E+08	430	nc	4.5E-07	22	nc	2.3E-08	82	nc	8.7E-08	6.9	nc	7.3E-09	13	nc	1.4E-08
Dichloroethene, 1,2-, cis-	nc	4.04E+07	ND	nc	0.0E+00	ND	nc	0.0E+00	5.8	nc	1.4E-07	ND	nc	0.0E+00	18	nc	4.5E-07
Methylene chloride	2.51E+07	4.21E+09	4.9	2.0E-13	1.2E-09	12	4.8E-13	2.9E-09	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00
Tetrachloroethene	2.81E+06	1.60E+09	2,400	8.6E-10	1.5E-06	1,500	5.3E-10	9.4E-07	1,500	5.3E-10	9.4E-07	1,100	3.9E-10	6.9E-07	1,400	5.0E-10	8.8E-07
Trichloroethane, 1,1,1-	nc	2.73E+10	ND	nc	0.0E+00	ND	nc	0.0E+00	ND	nc	0.0E+00	14	nc	5.1E-10	20	nc	7.3E-10
Trichloroethane, 1,1,2-	9.50E+05	1.09E+06	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00	6.4	6.7E-12	5.9E-06	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00
Trichloroethene	3.14E+06	1.08E+07	900	2.9E-10	8.4E-05	340	1.1E-10	3.2E-05	500	1.6E-10	4.6E-05	120	3.8E-11	1.1E-05	170	5.4E-11	1.6E-05
Trichlorofluoromethane	nc	3.43E+09	ND	nc	0.0E+00	ND	nc	0.0E+00	43	nc	1.3E-08	ND	nc	0.0E+00	8.7	nc	2.5E-09
Trichlorotrifluoroethane, 1,1,2-, 1,2,2-	nc	1.64E+11	150	nc	9.2E-10	39	nc	2.4E-10	73	nc	4.5E-10	15	nc	9.2E-11	13	nc	7.9E-11
Cumulative (multi-chemical)				**1.2E-09**	**8.6E-05**		**7.5E-10**	**3.3E-05**		**7.4E-10**	**5.4E-05**		**4.7E-10**	**1.2E-05**		**5.8E-10**	**1.7E-05**

Notes:

(1) The cancer risk or noncancer hazard associated with each detected concentration is calculated by ratioing the result to the cancer- or noncancer-based screening level, and multiplying by the target risk (1E-06) or target hazard quotient (1.0).

(2) Non-detect results are assumed to be zero.

Table 20. Outdoor Air Cumulative Risk and Hazard – Site-specific Evaluation

Chemical	Soil Gas RBSL		VSP-061611-SVE-6S			VSP-061611-SVE-7S			VSP-061611-SVE-7S-DUP		
	Cancer (µg/m3)	Noncancer (µg/m3)	Conc. (µg/m3)	Risk	Hazard	Conc. (µg/m3)	Risk	Hazard	Conc. (µg/m3)	Risk	Hazard
Acetone	nc	9.65E+10	15	nc	1.6E-10	23	nc	2.4E-10	20	nc	2.1E-10
Butanone, 2-	nc	2.40E+10	ND	nc	0.0E+00	ND	nc	0.0E+00	ND	nc	0.0E+00
Chloroform	4.98E+05	4.01E+08	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00
Dichloroethane, 1,1-	1.00E+07	4.01E+09	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00
Dichloroethane, 1,2-	4.39E+05	2.85E+07	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00
Dichloroethene, 1,1-	nc	9.46E+08	18	nc	1.9E-08	38	nc	4.0E-08	38	nc	4.0E-08
Dichloroethene, 1,2-, cis-	nc	4.04E+07	ND	nc	0.0E+00	ND	nc	0.0E+00	ND	nc	0.0E+00
Methylene chloride	2.51E+07	4.21E+09	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00
Tetrachloroethene	2.81E+06	1.60E+09	370	1.3E-10	2.3E-07	1,000	3.6E-10	6.3E-07	970	3.5E-10	6.1E-07
Trichloroethane, 1,1,1-	nc	2.73E+10	ND	nc	0.0E+00	ND	nc	0.0E+00	ND	nc	0.0E+00
Trichloroethane, 1,1,2-	9.50E+05	1.09E+06	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00	ND	0.0E+00	0.0E+00
Trichloroethene	3.14E+06	1.08E+07	59	1.9E-11	5.5E-06	160	5.1E-11	1.5E-05	150	4.8E-11	1.4E-05
Trichlorofluoromethane	nc	3.43E+09	ND	nc	0.0E+00	ND	nc	0.0E+00	ND	nc	0.0E+00
Trichlorotrifluoroethane, 1,1,2-, 1,2,2-	nc	1.64E+11	14	nc	8.5E-11	33	nc	2.0E-10	30	nc	1.8E-10
Cumulative (multi-chemical)				**1.5E-10**	**5.7E-06**		**4.1E-10**	**1.6E-05**		**3.9E-10**	**1.5E-05**

Notes:

(1) The cancer risk or noncancer hazard associated with each detected concentration is calculated by ratioing the result to the cancer- or noncancer-based screening level, and multiplying by the target risk (1E-06) or target hazard quotient (1.0).

(2) Non-detect results are assumed to be zero.

Table 21. Summary of Outdoor Air Cumulative Risk and Hazard

	Default Evaluation		Site-specific Evaluation	
Soil Gas Sample	Cancer Risk	Noncancer Hazard Index	Cancer Risk	Noncancer Hazard Index
VSP-061611-SVE-1	1.2E-08	8.5E-04	1.2E-09	8.6E-05
VSP-061611-SVE-2S	7.4E-09	3.3E-04	7.5E-10	3.3E-05
VSP-061611-SVE-3S	7.3E-09	5.3E-04	7.4E-10	5.4E-05
VSP-061611-SVE-4S	4.6E-09	1.2E-04	4.7E-10	1.2E-05
VSP-061611-SVE-5S	5.7E-09	1.7E-04	5.8E-10	1.7E-05
VSP-061611-SVE-6S	1.5E-09	5.7E-05	1.5E-10	5.7E-06
VSP-061611-SVE-7S	4.0E-09	1.5E-04	4.1E-10	1.6E-05
VSP-061611-SVE-7S-DUP	3.9E-09	1.4E-04	3.9E-10	1.5E-05

Appendix A

Geotechnical Laboratory Report

SPEEDIE AND ASSOCIATES
Geotechnical ■ Environmental ■ Materials Engineers
3331 EAST WOOD STREET • PHOENIX, ARIZONA 85040

LABORATORY REPORT

Physical Properties of Soils and Aggregates

Client:	Clear Creek Associates, PLC	Project No.	120880LA
Attention:	Geno Mammini	Report Date:	07-09-12
	6155 E. Indian School, Suite 200		
	Scottsdale, AZ 85251		

Project:	Romic Project				
Location:	Confidential				
Material:	In-Place (Sleeve)	Sampled By:	D. Giles	Date:	06/28/12
Source/ID:	Listed Below	Submitted By:	D. Giles	Date:	06/28/12
Supplier:	Unknown	Authorized By:	Client	Date:	06/28/12

Laboratory Test Results

Speedie Lab ID	Sample Location	Total Organic Carbon (%)	Wet Density (pcf)	Dry Density (pcf)	Moisture content (%)	Soil Specific Gravity (20°C)	Porosity (%)	Volumetric Water Content (%)
374153	GTB-01 @ 16.0'-16.5'	Not Tested	126.8	103.3	22.7	2.571	36.59	37.04
374154	GTB-01 @ 5.5'-6.0'	Not Tested	122.7	111.6	9.9	2.688	33.47	17.78

Test Methods Used:

Laboratory Determination of Water Content of Soil & Rock by Mass (ASTM D2216)

Density of Soil In Place by the Drive-Cylinder Method (ASTM D2937)

Specific Gravity of Soil Solids by Water Pycnometer (ASTM D854)

Comments:

Reviewed by ______________________
Laboratory Manager

SPEEDIE AND ASSOCIATES
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PARTICLE SIZE ANALYSIS OF SOILS - HYDROMETER
ASTM D-422

CLIENT:	**Clear Creek Associates, PLC**	SAMPLED BY:	**D. Giles**	DATE:	**6/28/2012**
PROJECT:	**Romic Project**	SUBMITTED BY:	**D. Giles**	DATE:	**6/28/2012**
PROJECT NC	**120880LA**	TESTED BY:	**WSH**	DATE:	**7/5/2012**
MATERIAL:	**In-Place (Sleeve)**	REVIEWED BY:	**BSW**	DATE:	**7/9/2012**
SOURCE/ID:	**GTB-01 @ 16.0' - 16.5'**			LAB NO:	**374153**

DISPERSION SAMPLE

Air Dry Wt., gms	60.18
Specific Gravity of Soil	2.571
Specific Gravity of Liquid	1.000

HYGROSCOPIC MOISTURE SAMPLE

Wt. of Container + Air Dry Sample, gms	35.04
Wt. of Container + Oven Dry Sample, gms	34.95
Wt. Container (tare), gms	19.40
Hygroscopic Moisture Content, %	0.58%

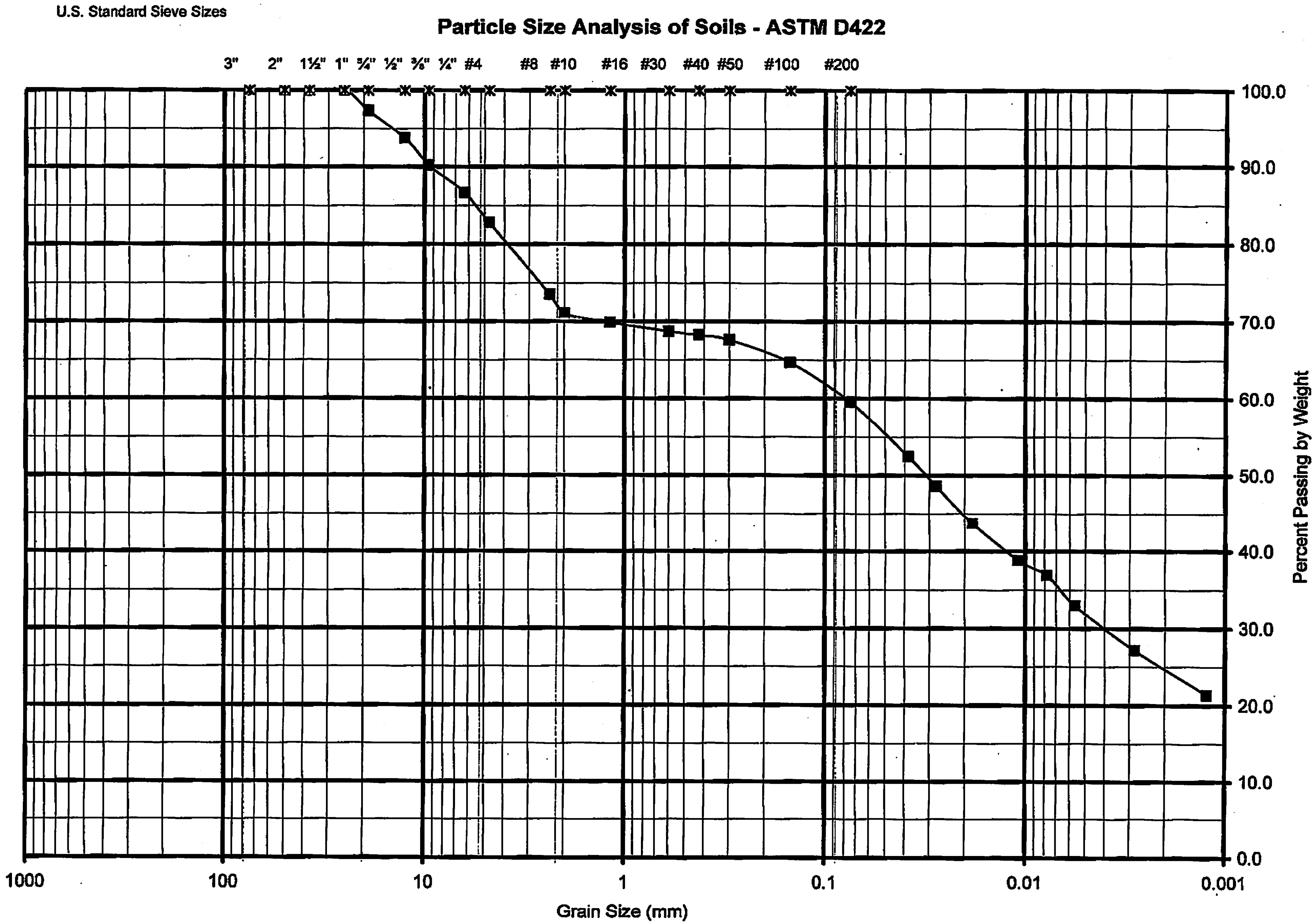
HYDROMETER CALCULATIONS

Wt. Soil Dispersed, gms	59.83
Oven Dry Mass - Total Sample, gms	84.20
% Gravel	17.2
% Sand	23.3
% Silt	35.4
% Clay	24.1

SIEVE ANALYSIS

Sieve Size	Percent Passing
3"	100.0
2"	100.0
1½"	100.0
1"	100.0
3/4"	97.3
1/2"	93.7
3/8"	90.2
1/4"	86.6
#4	82.8
#8	73.5
#10	71.1
#16	69.9
#30	68.7
#40	68.2
#50	67.6
#100	64.7
#200	59.5
.020 mm	44.6
.005 mm	31.7
.002 mm	24.1
.001 mm	20.5

Elapsed Time, (minutes)	Temp °C	Hydrometer Reading	Correction	R - Corr	Percent Passing	Effective Depth (L), (cm)	Constant (K)	Particle Diameter, (mm)
1	25.2	1.0300	0.0030	1.0270	52.5	8.4	0.01318	0.038200
2	25.3	1.0280	0.0030	1.0250	48.6	8.9	0.01318	0.027804
5	25.2	1.0255	0.0030	1.0225	43.7	9.7	0.01318	0.018358
15	25.3	1.0230	0.0030	1.0200	38.9	10.2	0.01318	0.010869
30	25.3	1.0220	0.0030	1.0190	36.9	10.5	0.01318	0.007797
60	25.3	1.0200	0.0030	1.0170	33.0	11.0	0.01318	0.005643
250	25.5	1.0170	0.0030	1.0140	27.2	11.8	0.013105	0.002847
1440	25.1	1.0140	0.0030	1.0110	21.4	12.6	0.01318	0.001233



374153- Hydrometer Report

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PARTICLE SIZE ANALYSIS OF SOILS - HYDROMETER

ASTM D-422

CLIENT:	**Clear Creek Associates, PLC**	SAMPLED BY:	**D. Giles**	DATE:	**6/28/2012**
PROJECT:	**Romic Project**	SUBMITTED BY:	**D. Giles**	DATE:	**6/28/2012**
PROJECT NC	**120880LA**	TESTED BY:	**WSH**	DATE:	**7/5/2012**
MATERIAL:	**In-Place (Sleeve)**	REVIEWED BY:	**BSW**	DATE:	**7/9/2012**
SOURCE/ID:	**GTB-01 @ 5.5' - 6.0'**			LAB NO:	**374154**

DISPERSION SAMPLE

Air Dry Wt., gms	60.66
Specific Gravity of Soil	2.688
Specific Gravity of Liquid	1.000

HYGROSCOPIC MOISTURE SAMPLE

Wt. of Container + Air Dry Sample, gms	37.65
Wt. of Container + Oven Dry Sample, gms	37.55
Wt. Container (tare), gms	19.48
Hygroscopic Moisture Content, %	0.55%

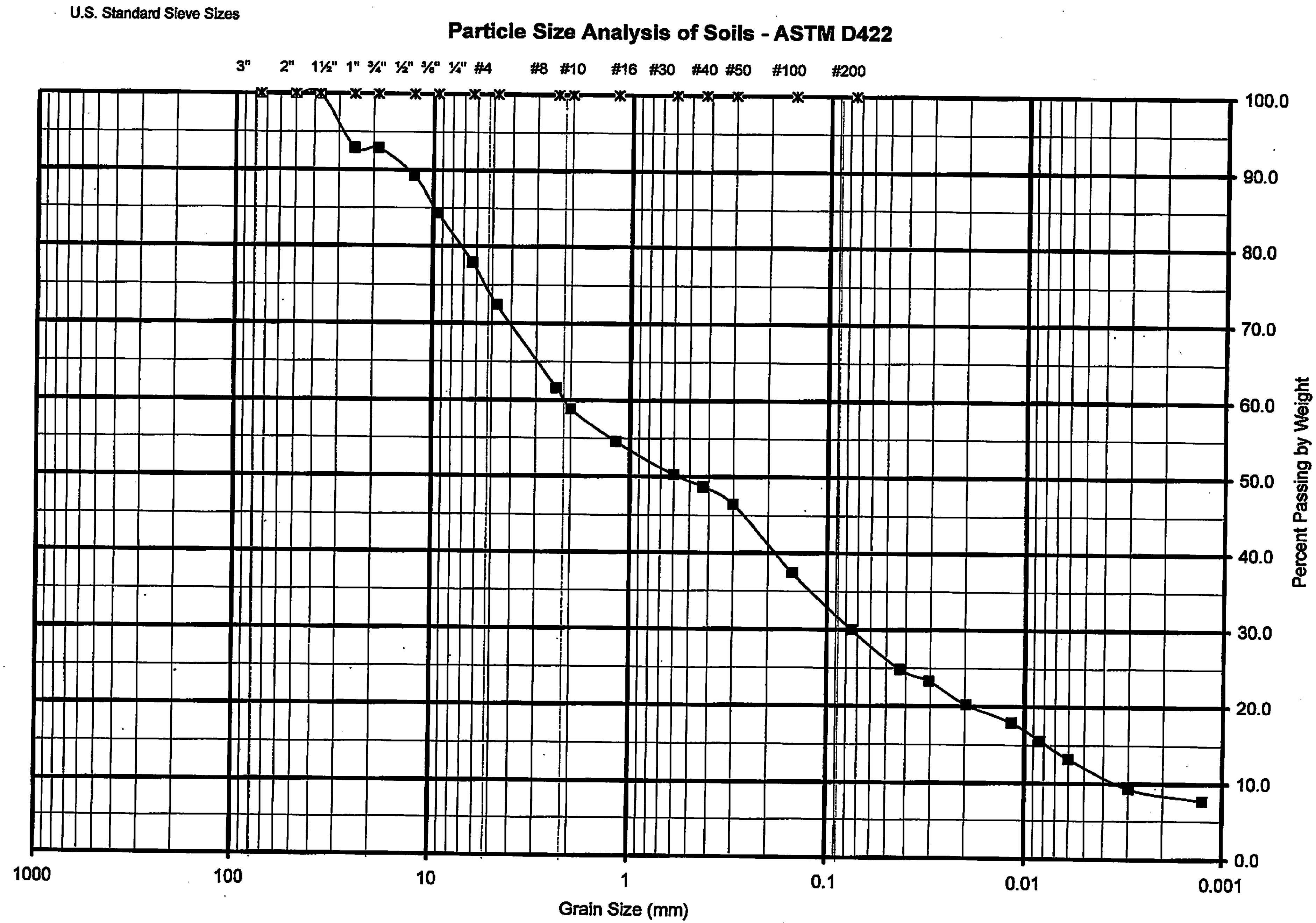
HYDROMETER CALCULATIONS

Wt. Soil Dispersed, gms	60.33
Oven Dry Mass - Total Sample, gms	102.49
% Gravel	27.6
% Sand	42.4
% Silt	21.5
% Clay	8.4

SIEVE ANALYSIS

Sieve Size	Percent Passing
3"	100.0
2"	100.0
1½"	100.0
1"	92.9
3/4"	92.9
1/2"	89.2
3/8"	84.3
1/4"	77.9
#4	72.4
#8	61.6
#10	58.9
#16	54.6
#30	50.3
#40	48.7
#50	46.5
#100	37.4
#200	30.0
.020 mm	20.3
.005 mm	11.9
.002 mm	8.4
.001 mm	7.5

Elapsed Time, (minutes)	Temp °C	Hydrometer Reading	Correction	R - Corr	Percent Passing	Effective Depth (L), (cm)	Constant (K)	Particle Diameter, (mm)
1	25.2	1.0190	0.0030	1.0160	24.9	11.3	0.012715	0.042744
2	25.2	1.0180	0.0030	1.0150	23.3	11.5	0.012715	0.030491
5	25.2	1.0160	0.0030	1.0130	20.2	12.1	0.012715	0.019781
15	25.2	1.0145	0.0030	1.0115	17.9	12.6	0.012715	0.011654
30	25.2	1.0130	0.0030	1.0100	15.5	12.9	0.012715	0.008338
60	25.3	1.0115	0.0030	1.0085	13.2	13.4	0.012715	0.006009
250	25.5	1.0090	0.0030	1.0060	9.3	13.9	0.012645	0.002982
1440	25.1	1.0080	0.0030	1.0050	7.8	14.2	0.01272	0.001263



374154- Hydrometer Report